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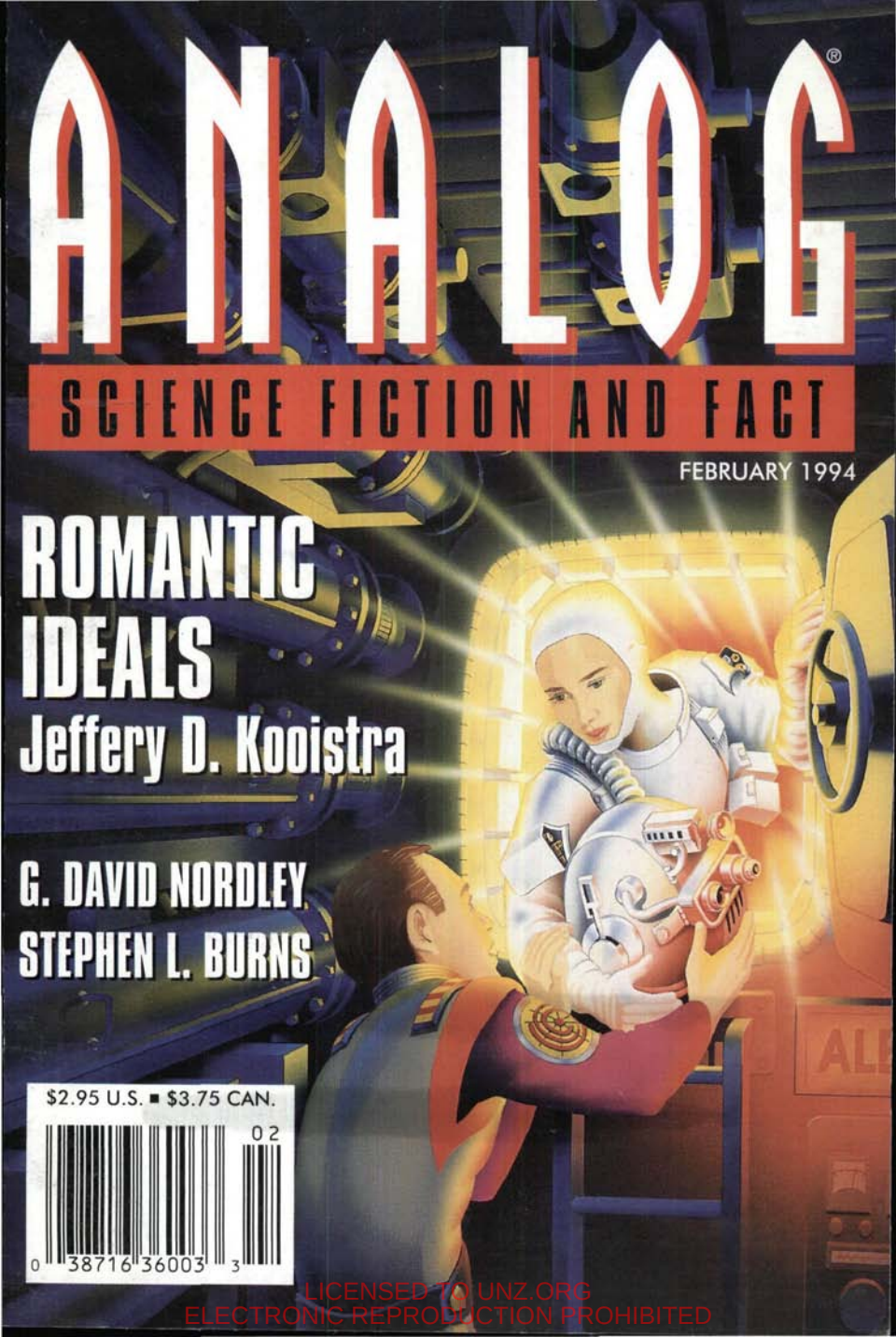

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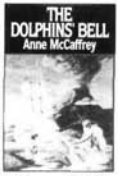

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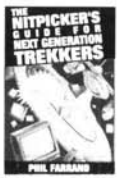

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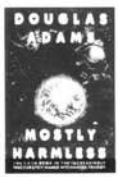

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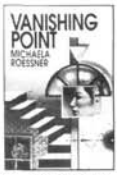

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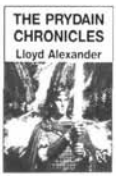

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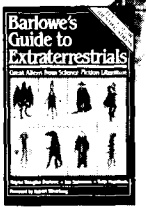

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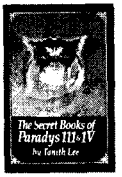

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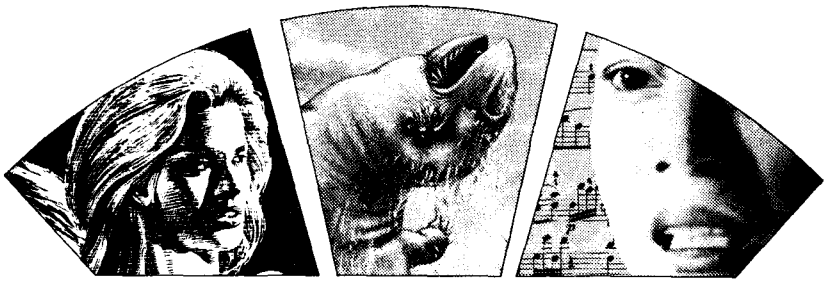

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EDITORIAL Stanley Schmidt

MEGACHOICE

One of the most controversial things *Analog* has published recently was not a story, not an editorial, but two paragraphs one of our authors wrote in reply to a "Brass Tacks" letter commenting on a science fact article.

Paul Birch's article, "A Visit to Suprajupiter" (December 1992), described a grandiose and imaginative scheme for building an artificial habitat completely surrounding Jupiter that could be inhabited by vast numbers of people. Reader John Vester, in his letter published in August 1993, applauded Suprajupiter as an imaginative exercise but expressed some concerns about *why* such a project might be undertaken, a question not given much attention in the original article.

As we often do in such cases, we forwarded a copy of Mr. Vester's letter to Mr. Birch in case he wished to run a reply when we printed it in "Brass Tacks." His seven-paragraph response included these comments: "I believe we must fill the Universe and subdue it, because God made it for us and commands us to." And, "As for finding a way out of the Malthusian trap, we were never in it.... Even on Earth, current technology would allow population to grow by *at least* a further factor of 40,000.... The terrestrial environment is nowhere near destruction; we've *not* spoilt it, we've improved it. The so-called limits to growth are nonexistent."

And then the fun began.

Those two paragraphs drew more mail than many whole stories or articles. You'll see some of it in Brass Tacks—including, at the very least, Vester's own reply. Some readers were shocked that we would print such statements. One believed that they destroyed the credibility of anything else the author ever said. Others disputed them heatedly and in detail. Some wondered whether they were even meant to be argued seriously, or whether they were said with tongue in cheek to provoke thought and discussion.

Since just such provocation is well known to be one of *Analog*'s most characteristic (and useful) activities,

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I would never have considered suppressing Mr. Birch's comments, no matter how much or how little I agreed with them. Nor do I believe, even if they are utterly wrong, that they destroy every shred of his credibility. Everything *anybody* says is subject to doubt and question. Nothing should be considered automatically believable because a Good Source says it, and the utterance of one piece of sheer nonsense does not invalidate every sound statement a person has made (though it may *reduce* his credibility). Most of us have uttered nonsense more than once, whether intentionally or un, and most of us would be in sad shape if that meant nobody should ever listen to us again.

I frankly don't know whether Mr. Birch seriously believed everything he said, nor do I care. I asked for his response to a letter commenting on his article; I printed it; and I'm glad to see it stirring up heated discussion.

But I do think his points are open to serious debate and criticism—and, sadly, I don't think that, by their very nature, that debate can be resolved to everybody's satisfaction. Because a crucial part of the answer involves personal preferences—tastes—and a course of action that pleases people with one sort of taste will be violently displeasing to those with another sort.

Point 1: Mr. Birch, like anyone else, may believe whatever he chooses about what, and for what reasons, "God made . . . and commanded." He *cannot* expect such arguments to carry any weight at all with people who don't happen to share those beliefs. So while they may explain his personal advocacy of a particular course of action, they in no way justify anyone else's following that course. It may be a good one, but if so, it needs other justifications.

I found myself thinking of this part of the argument during a Westercon panel on morals and ethics in science fiction, when a member of the audience raised an interesting and pertinent question. Even if you do accept the "God commanded . . ." argument, he asked, "If God said, 'Be fruitful and multiply,' did he mean *forever?*"

Point 2: Hardly anybody these days believes that there are *no* limits to growth, or that Malthus's basic idea had no merit at all. He was wrong about the details, but even the most optimistic proponents of highly advanced technologies like nanotech-

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nology—or at least the ones who've taken a close look at numbers—concede that the basic idea was right: the population of any given system *cannot* grow indefinitely. The limits are farther out than Malthus thought, but that doesn't mean there are *no* limits.

Most of the controversy Paul Birch has provoked centers on his specific claims about the system all our current (known) readers inhabit: the one we call Earth. Can it really support more than 200 trillion people? Even if it can, *should* it? Has human activity really improved our environment more than it has messed it up?

On the last question, we run smack up against those questions of taste. Some people *like* living in densely-populated cities; some hate it. On the first question, we're dealing with a conjecture on which people of many persuasions would like to believe more than they can prove.

One comment that came up on that morality and ethics panel expressed a common belief that may contain too much wishful thinking to be a solid argument. It maintains that we *can't* run this planet's population up that high because we're too dependent on all the other species that live here. Wipe out too many more of them, the argument goes, and *Homo sapiens* will soon follow.

That may be true—or it may not. Personally, I would like to preserve a high level of diversity, but I'm not at all sure that that particular argument is strong enough to convince people who disagree with me. Very probably, the spotted owl, in and of itself,

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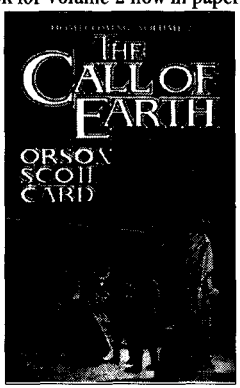

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is *not* necessary to our survival. Neither is the snail darter. Our present ecosystem is not the only possible or viable ecosystem—or even the only one containing our species as an important component. As a hard science fiction writer, I find it uncomfortably easy to imagine a future in which our descendants *have* wiped out almost all other natural lifeforms, and developed a new, simpler, entirely artificial ecosystem designed for the sole purpose of supporting vast numbers of *us*. I don't think anybody *now* understands ecology well enough to do it, but I can imagine enough being learned to make it possible in the future.

But I don't for a minute think that it *should* be done.

Why? With such questions, quite frankly, we're getting down to the level of ethics that depends on principles accepted without proof—the moral equivalent of geometrical axioms. It's as hard to convince somebody logically of those as it is for Mr. Birch to convince a nonbeliever that everybody should do what his God allegedly commanded.

So I'm reduced to saying that maybe we *can* do away with most other lifeforms, but we shouldn't anyway—if only because it would be a nasty thing to do. As the naturalist-philosopher Joseph Wood Krutch wrote in 1955, "Albert Schweitzer remarks somewhere that we owe kindness even to an insect when we can afford to show it, just because we ought to do something to make up for all the cruelties, necessary as well as unnecessary, which we have inflicted upon almost the whole of animate creation. Probably not one man in ten is capable of understanding such moral and aesthetic considerations, much less of permitting his conduct to be guided by them. . . ." That number is probably a bit higher now, but needs to be still higher if diversity is to be preserved.

The argument that we *need* all those other species to survive is simply too shaky to rely on, so those of us who believe we need them for other reasons need other arguments. A large number of people simply believing that diversity is intrinsically desirable, and that ethical considerations can apply not only to our treatment of other *human* beings but to our treatment of other *beings*, may be the best we can do.

In any case, returning to the original point, the answer to the question of whether Earth *can* support the human population Mr. Birch claims may well be *yes*. On whether it *should*, he and I pretty obviously differ. I've already discussed one reason; others bring us back to the realm of personal taste.

Mr. Birch says flatly, "We've not spoilt [the environment], we've improved it." A good many readers disagreed vehemently. What they're all really saying is: Mr. Birch likes it better than he used to; some other people like it less.

My own answer would be mixed. I certainly prefer my present life expectancy to the one I would have had in any century before this one, and I'm grateful that I now have the ability to get around and experience firsthand far more of the world's diversity than

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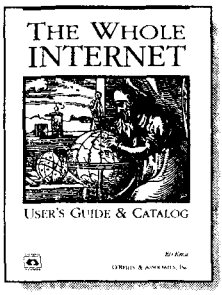

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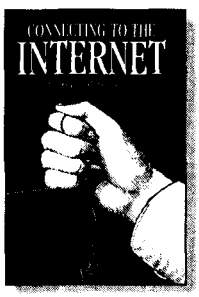

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most of my ancestors could. On the other hand, I'm sorry to see so much of that diversity being homogenized and paved over, and to see so much of the population crowded into such tight spaces that they're living in squalor and clawing at each other like rats in too small a cage.

If you read over that last paragraph, you may notice an interesting and significant pattern in what I like and don't like. In general, the things I consider steps backward are directly associated with high population density. It's true that I am, by choice perhaps influenced by where various parts of my upbringing were spent, primarily a country boy—but I am not unique. I realize that some people prefer living in densely-populated areas; and even I freely admit that cities produce not only conditions I dislike, but things that I like very much and can find nowhere else. Great museums, libraries, theaters, orchestras, and restaurants are very much products of cities, for reasons that are easily understood in terms of our past history. (They may be less pertinent in some possible futures, but that's another essay!) But I would rather live in the country and make an occasional trip to the city to enjoy those things, than live full-time amid congestion and noise and pollution to be near them.

So would a great many other people. The observation that so many people who can afford to prefer to live outside urban congestion is, I think, very relevant to Birch's vision of an Earth of 200 trillion. We might well be able to do it, and some people would love it. Others would not—but they would have no choice.

Tastes differ: some people like high population densities; some detest them. This is not the same as liking or not liking people. I tend to like people, as individuals, when I get to know them; I do *not* like crowds. I like people; I also like jalapeño peppers—but I don't think the best thing that could be done for the world is to fill it with either.

My biggest problem with Mr. Birch's vision of that superpopulated Earth, I think, is that it leaves very little room for diversity—not just of species, but of human tastes and lifestyles. I refer specifically to this matter of preference for high or low population density. Our present Earth, we know, contains people of both extreme types, and everything in between. It offers them all at least a modicum of choice. If you're stuck in a city and long for quiet and elbow room, there are still reasonably open spaces to which you can relocate—if not now, you can work toward it for the future. If you grow up bored stiff on a farm and crave company and excitement, you can move to the city.

Mr. Birch's vision, as I understand it, would eliminate that choice. If you populate a planet to its limit, whether that limit be 200 trillion or some other figure, pretty much everybody is going to be living under the most crowded possible conditions. And to me, that is a very, very serious flaw in such a vision as a goal for the future. My world has room in it for people who prefer his kind of living conditions; his has no room for my kind.

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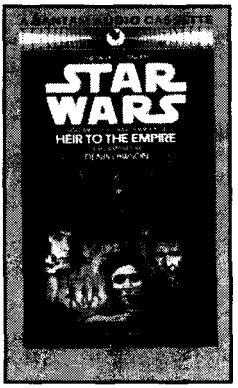

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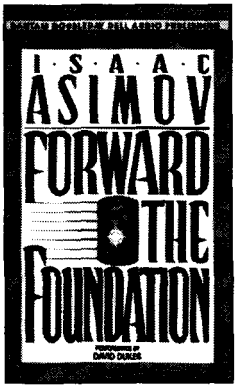

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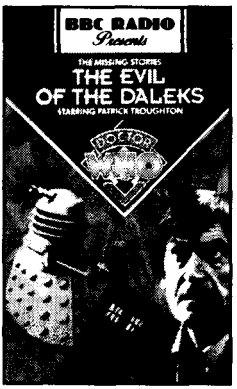

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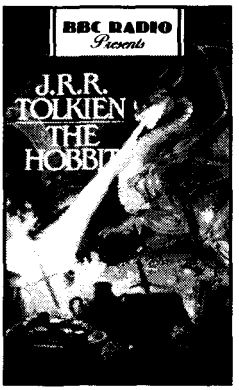

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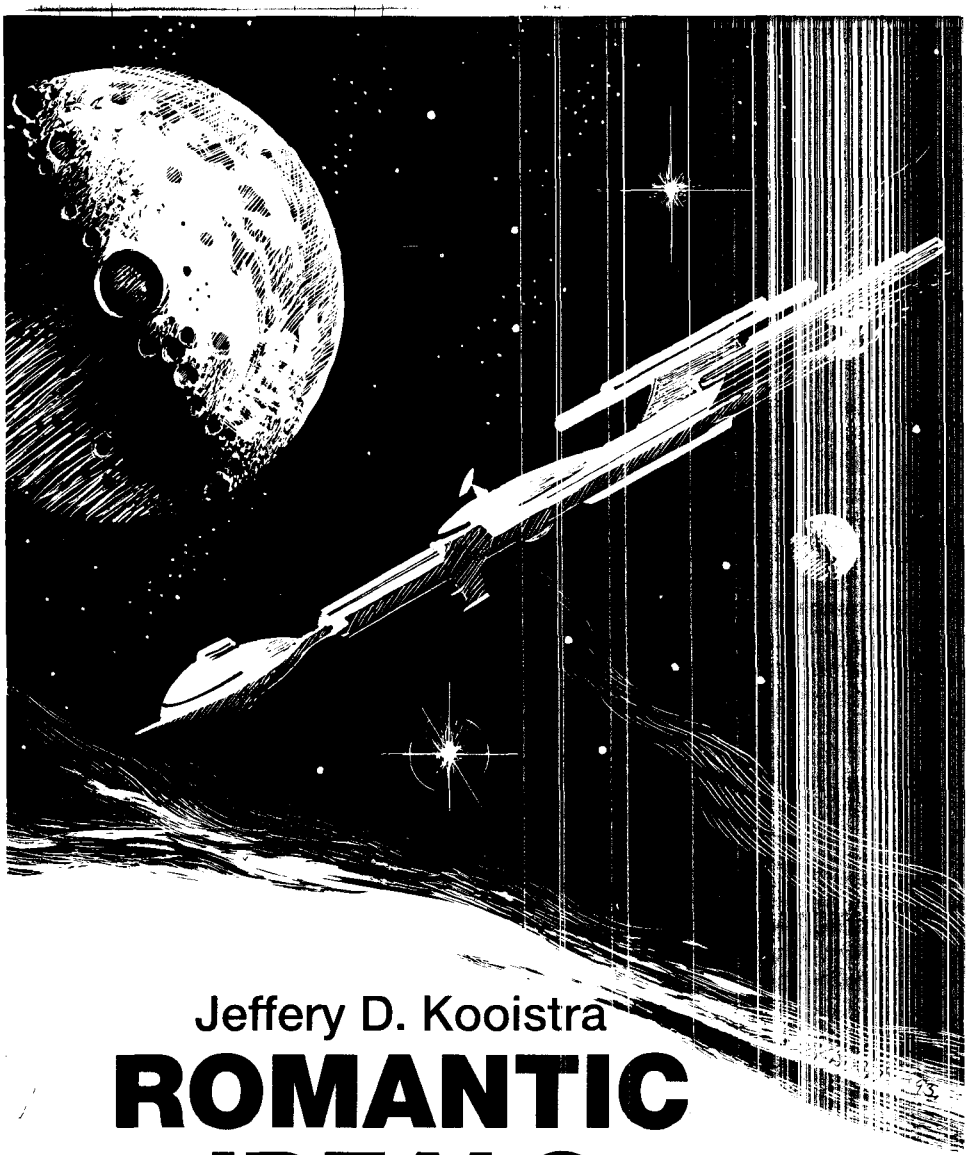

Jeffery D. Kooistra

ROMANTIC IDEALS

Reality doesn't always live up to ideals—but that doesn't mean they're not worth having.

Illustration by Vincent Di Fate

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In all the Universe of a hundred billion times a hundred billion stars, there was but one which shone as a sun upon the Human race.

Until recently, that is.

Chad Merrimack was second mate aboard the spaceship *Frisian Sea*, one of eight System Patrol cruisers equipped with the Dykstra-Hague hyperdrive. He was staring out at the stars, a common thing for him to do while the ship was sublight, taking her bearings. Soon she would return to hyperspace, and he wanted to watch as the stars did their crazy, rainbow-dazzle dance during the moments of transition.

For him, in all the history of the Universe, this was the greatest time to be alive. Chad had always been a fervent student of romantic ages —the age of sail, the age of steam, the early age of flight. He was living now in such an age—the age of starships.

Chad gazed out the viewport, noticing again the balanced beauty of the twin drive nacelles, engines harnessing incredible energies, though just barely. Engines that could take a fragile construction of Man and hurl it from star to star, port to port, from shore to galactic shore.

His wife owned those engines.

Chad looked down, to the bulge in the lower hull that lay between the roots of the two booms that supported the drive. Debra Anne had loved space even more than he, had fought and scraped and worked her tail off to be the best hypermotor engineer the Academy had ever seen. Right now she was down there, inside that bulge, discussing engineering details and budgets with the captain and the exec. She'd be trying to get what was best for her babies, he was sure.

He wondered if she'd told the captain yet about the other baby she had on the way.

He smiled as he looked at his watch. Ten more minutes to hyperdrive. The sightings would be finished by now. He felt a gentle tremor—the thrusters delicately adjusting the *Frisian Sea*'s momentum vector, so critical for making the ship emerge later in the proper space-time position. Soon would come the low throbbing, rapidly building to a soft booming of muffled kettledrums, and the sky would twist, the stars jump, their light prisming, and the ship would suddenly shake itself into a groove in the hyperrealm, the kettledrums replaced by a dull, continuous pounding.

He loved it, reveled in the sheer romance of ships that plied the lonely seas between the planetary islands.

One minute to go. Debbie would still be in her meeting. Captain Clarke was a solid commander, but he'd first been commissioned in pre-starflight days, and was sometimes slow on the technical uptake.

Chad watched and waited as the seconds ticked away, anticipating the taste of the sublime he always felt when the engines did their work.

The explosion came as a complete surprise.

Like a flare coming to life, the explosion dazzled him, and ripped away decking from the port engine boom, down near the root. The ship lurched, the jerk knocking him momentarily

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off his feet. As he stood he noticed the ship's gravity had fallen to half standard, which meant they were now on emergency standby. Outside he saw fire slicing up the port boom, as if someone with a giant acetylene torch were cutting open the hull from the inside.

Abruptly the fire went out.

"Disaster crew to engineering. Disaster crew to engineering," came over the PA. "Dr. Skorin, Mr. Merrimack, report to engineering immediately." As if he wasn't going to go without an order.

The disaster crew had arrived before he did, were humming and bustling through the engineering decks, racing across catwalks, disappearing into access tubes. Normally opened hatches were solidly shut, red flashing indicators pulsed everywhere.

Dr. Skorin was with Debbie. Chad found them in a corner.

There was really only one vision of his wife that came to mind whenever he thought of her, a memory from a time shortly after they'd met. Skiing in the Rockies, Debbie had proved to be far better than Chad. She loved the hard routes, and would never pass up the chance to take a jump. One time she hit a ramp crooked, was airborne and fighting to hold her line. She was silhouetted against the cobalt sky, her long blonde hair whipping wildly. And as Chad watched her face, while she was in combat against nature and gravity itself, he saw no fear, no terror, nor even worry, but only the most exquisite, pure white delight.

He didn't see it now.

Debbie was sitting up against the bulkhead, black streaks occluding her face, singes and sweat in her long hair, which had come undone from the severe professional bun of an on-duty engineer. Dr. Skorin was giving her a shot.

"Honey, are you all right? What happened?"

"Chad. I'll be—" she started, but it disintegrated into coughing.

"She's going to be fine," Dr. Skorin said. "She's a bit roughed up, has a couple of bruised ribs, but she'll be as good as new."

"And . . . ?" Chad asked.

"Yes, the baby should be fine, too. She's only a month along. There's no evidence of internal damage."

"Where's the captain?"

"He didn't make it," Debbie said, able to speak now. "I was showing Clarke and the exec where Kelly in physics wanted to put some monitors on the port energy conduit. As the energy flux climbed for transition, the captain noticed a rupture. . . ." She coughed again, and continued. "The old bird saw the trouble before I did. He fairly threw me through the hatch just before it blew. The pressure dropped and the hatch slammed shut.

"I owe the captain my life, Chad. I should be dead now."

Chad put his arms around her. Dr. Skorin left to attend to other casualties. "No one should be dead now," he whispered.

After a while Chad noticed that the bustling had settled. He was still tending to Debbie, gently stroking her face when a shadow fell over him.

"Commander Merrimack?" It was

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Midshipman Akiyama.

"Yes? What is it?"

"Uh . . . what do you want us to do now, sir?"

Chad looked up. "Why . . ." he began, only to have the facts of the situation sink in.

"The captain is dead, sir. So is the first. It's your command now, sir."

Debbie moved to pick herself up off the floor. Chad helped her to her feet. "Go be captain, Chad," she said. "I'll be all right. And I have work to do." She looked around her engine room and shook her head. "A lot of work."

"Dr. Skorin, would you fill us in on the casualty list?" Chad said, physically but not emotionally comfortable in the captain's seat at the conference table. The senior staff was present, his staff now. Debbie was seated to his right. Though cleaned up, the explosion having taken place hours ago, Chad could see the outline of the rib support underneath her uniform. Navigator Rashid was present, technically his first officer, as was Kelly representing the scientist complement, and the doctor.

Skorin said, "Four dead, including the captain and the exec. Five others are what I call the walking wounded, including Chief Merrimack." He gestured toward Debbie. "That leaves three others in sick bay: Carver, Genali, and Johnson."

"And their conditions?"

"They've had severe radiation exposure, as well as all suffering from more prosaic internal injuries. The long and the short of it is that I can keep them alive for another week, but if we don't get them to a real hospital at a colony system they're all going to die."

"I see. Mr. Rashid, your report please."

"We're just over a third of a light-year from Delta Pavonis. We can be there in five days from the moment we get the drive fixed."

"But how long will it take us to reach Purgatory from the Hague Limit?" Chad asked. When in hyperdrive a starship couldn't approach a star any closer than its Hague Limit, a distance typically measured in the tens of astronomical units. The laws of hyperphysics would forever forbid faster-than-light travel within that radius.

"It doesn't matter," Skorin said. "The Delta Pavonis system has a large mining facility in the local Kuiper Belt. It's well beyond the system's Hague Limit. We can come out of hyperdrive practically on top of it."

"Good. Well, that leaves your report. . . ." he was about to say "hon," but caught himself. "Chief Merrimack. What shape is the drive in?"

"It's a mess, but we should be able to fix it. I'd like more time though. But if we're going to save those three in sick bay, I guess I've got less than two days."

"What exactly happened, Debbie?"

"A field flux guide went bad. It was only a matter of time before something happened, but it was cracked in an unusual place—our last inspection just didn't catch it. Anyway, when the energy stream increased for transition, the field failed at the point of the

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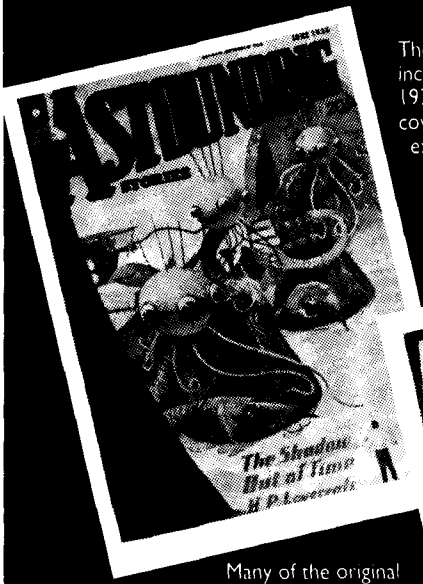

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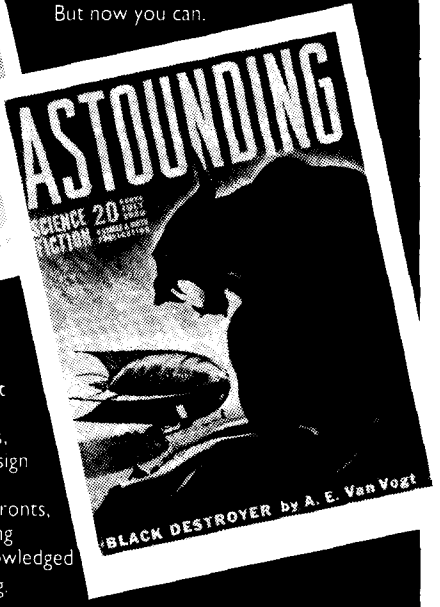

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bad guide and the conduit started to peel apart like an opening zipper.

"The port drive unit is still intact—didn't really suffer any damage at all. But it's unpowered until we get the energy conduit fixed. Right now we're modifying a mobile remote unit to make the repairs."

"*Why the modifications?*" Chad asked.

"It's hot in there—really high radiation levels. When a stream of metastable virtual particles break confinement they turn into the whole subatomic particle zoo. Even with the modifications I don't know how long the remote will hold up—its circuits will be fried by the time it's done, though."

"Could we send a man, uh, someone in wearing a rad suit?"

Debbie looked at him, giving him a sad smile, like she was reading his mind. "A person could work in there for a very short time. But I don't know if he'd be able to walk out."

"Wait a minute," Skorin interrupted. "Why do we need the port engine anyway? Can't we get back with one?"

It was Kelly who set the doctor straight. "The *Frisian Sea* doesn't have two engines, Doctor. It's a common mistake. The two nacelles each hold one element of a single drive —they're both needed to make the ship enter hyperspace."

"He's right," Debbie said. "If we don't get the port unit on line, we aren't going anywhere."

"OK then, everyone. We have work to do. Mr. Rashid, line our vector up to bring us as close to that Delta Pavonis mining colony as possible. Dr. Skorin, see if there's any way you can think of to keep those men alive longer than a week. Chief Merrimack—"

Debbie looked at him and saluted, eyes twinkling.

"Very good, Chief. Kelly, see what your people can do to help out in engineering."

There had been eighty men and women in the crew of the *Frisian Sea,* but now four were lost, and three others probably would be. And the ship was stuck a large fraction of a light-year away from the nearest colony, with a broken hyperdrive and an inexperienced officer in charge.

Chad had always known in his head what the problems of command would be, what a nightmare the duties could become, but now he was beginning to feel them in his heart, in his bones, in the soreness of his neck muscles as his body refused to ignore his stress, even though *he* was trying to.

He and Debbie had often made what they'd thought were harmless jokes about Captain Clarke, his old-fashioned ways, how silly it was to have someone from pre-starflight days be the commander of a starship. But now Chad knew why experience was important, what an edge it had given the captain, an edge that Chad didn't have. And Clarke had saved Debbie's life. *Would I have been able to see the danger?* Chad wondered. *Would my response have been as swift? And selfless, if it had been someone else's wife?*

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Upon entering the sick bay, Dr. Skorin led him to the beds where the three men lay. They were asleep, and from the looks of their injuries, that was certainly a blessing, one bestowed upon them by the doctor.

"You see, Chad," Skorin said. "We just don't have the facilities aboard to take care of this much radiation trauma. Too many different organs have to be stimulated to regenerate. These guys are looking at three months in a hospital, but only if we can get them to a hospital."

"Debbie's working on it." Dammit! Why did it have to be like this? If the three had just died, then Debbie could have weeks to effect repairs. If they were healthier, she'd still have more time. But their lives hung in the balance, demanding the best efforts the rest of the crew could give to save them.

What had he been thinking about just—he looked at his watch—ten hours ago? The romance of star flight. How romantic to ply the sea between stars. How romantic to risk your life riding a bomb to touch the stars.

But now there were three men near death in sick bay. Three men that were now his responsibility. And seventy-two others, too.

It didn't seem so romantic after all.

"Is there anything you can do to give us more time?"

Skorin shrugged. "No. When I told you a week was the max, that's what I meant. If we get moving now, we've got a good chance that they'll all make it. Otherwise, no."

Chad left the sick bay, but the burdens of command went with him. Half-way down the corridor to the control room he was intercepted by Midshipman Akiyama with a report to sign for the disaster crew. Once inside, the bridge crew required an order to allow them to violate regulations and commit the ship to that minimum distance breakout point. Upon taking his seat in the captain's chair he was immediately called upon to order Kelly to relinquish some lab equipment that Debbie needed to cannibalize for her repairs. He'd had to get loud on the intercom to do that. He knew how it looked—like he was playing favorites.

Having a loved one as a subordinate brought along a host of new worries he hadn't thought about.

"Course plotted and laid in, Captain," Rashid said. "Now all we need are some legs to take us along it."

Later, Chad called Debbie from their cabin.

"Husband to wife, how are the repairs going? Are we going to get done in time to save the men?"

"My dear, I'm not going to tell you anything different than I'd have told Captain Clarke. We have the remote unit modified and it's making repairs now. But it's still touch and go. It's not just a race to finish in thirty-six hours to save the men. It's a race to finish before the remote gives out. I'm getting all the heavy work done now. Assuming it lasts through that, I'll have to operate it myself to do the delicate circuitry connections."

"Why you?"

"Sweetie, I had to redesign some things, take a few shortcuts, to give us a chance to finish this in time at

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all. I'm the only one that knows *how*." He knew she was smiling.

"You're so good. Want to sleep with the captain tonight?"

"I'm looking forward to it."

Finally together, worn and frazzled, naked in the dark. Despite the trials of the day, they made love vigorously, desperately, as if there were no tomorrow. Chad was surprised by Debbie's appetite, like she couldn't get enough of him, her legs wrapped around him so tight he doubted if he could get away. But of course he didn't want to.

Later, thoroughly spent, they lay together spoon fashion. Chad thought Debbie was sleeping, heard the soft, rhythmic sighing of her breath. He loved this woman, had loved her from the start.

They'd met at the Academy. She was pursuing engineering and hyperphysics studies, and he was traveling the fast track to a command position. Their one overlapping course had been English Literature, and it was there that they discovered a shared love for Shakespeare and Blake. And Kipling—you couldn't forget Kipling. On their first date they'd sung from *Barrack-Room Ballads* until they were both hoarse.

He'd told her he'd never met anyone like her. She'd told him that *nobody* had ever met anyone like him. They'd married after six months, taking their vows before God and family and friends . . . for richer, for poorer . . . in sickness and in health . . . until death. . . .

Chad joined his wife in slumber.

* * *

Chad awoke to the beeping of the intercom. He discovered that Debbie was sleeping with her head on his chest and her arms around him, and it took a few moments to disentangle himself and answer the comm.

"Merrimack here. What is it?"

"Uh, Captain, this is Engineer's Mate Gunderson, sir. Um, is Chief Merrimack there? I need to talk to her."

"I see. She's sleeping, Mr. Gunderson. I assume this is urgent?"

"It can't wait, sir. Sorry."

"I'll take it," Debbie said, awakened by the talk. "What is it, Lars?"

"The remote gave up the ghost, Chief. The heavy work is done, but it's frozen up now."

"Dammit! All right. I'll be right down," Debbie said. She signed off.

Chad watched her dress in the dim light. He could feel worry trying to break in. He fought it.

She saw his face. "Don't worry about me, Chad. I'll probably be able to get it working again. There are a few tricks left I can try."

"This is strange," Chad said. "I know I could order you to stay. I even want to."

"But you won't," Debbie said, finishing with the last clasp.

"Because I'm captain now?"

She came to him, kissing him gently on the cheek. "Because you're *you*, Chad," she said, and was gone.

He tried to make himself sleep after she left. He was captain after all, and this was an emergency, and it wouldn't do to be fatigued at some critical moment. But he couldn't. The

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rat of worry was again gnawing at him, forcing his mind to play out scenario after scenario of what could go wrong, and what he'd have to do then, and what else could go wrong after that.

He caught up with Debbie at 600 hours. She was tucked in at the controls of the remote, her brow furrowed in concentration, her eyes locked into the optic field. He came up beside her, inadvertently startling her.

"Stop scaring people!" she snapped.

"Sorry, Debbie."

They noticed the stares the others in the control room were giving them.

"Oops. Sorry, Captain. You just surprised me." She gave him a tired smile, then turned back to her work.

"You got it working?"

"Barely. I'm spending half my time fixing the drive and the other half keeping the remote from giving out again. But I'm 80 percent done. You can tell Skorin we should be able to go in another couple of hours."

"Good work, Chief," Chad said. Then he leaned down and whispered, "And I love you, too." He left engineering and went up to the bridge.

Disaster struck again, but quietly this time, with just the soft chiming of the intercom. "Merrimack here," he answered.

"Chad, you'd better get down here," Debbie said.

"Did something else go wrong?"

"Yes, the remote gave out again. But we have an idea for what to do about that. I need you to come down here to discuss it."

A door unlocked and dread came out as he headed back for the engineering deck. So the remote had failed again. That meant the repairs couldn't be finished in time, and the three in sick bay would die. But Debbie and her crew had worked up a plan, but they needed to talk to him in person about it. Check that—*Debbie* needed to talk to him.

When he arrived, he was all business. "How far away from being finished were we when the remote quit?" he asked of the semicircle of engineers.

Debbie emerged from the ranks and said, "Twenty-five, thirty minutes. But Chad, I need to talk to you."

Chad just stared at her, but she didn't wilt. Finally, he said, "If it's about . . . someone . . . going in to finish the job in person, you can forget it. I won't order a man to do it."

"You have a volunteer," Debbie said. "I just happen to be the only person who can make the repairs anyway."

"That's enough, Deb! You're not going to go in there. The radiation levels will kill you."

"Not necessarily."

"It's too dangerous."

"If I don't do it those three men will die."

"They'll probably die anyway!"

"No, they won't." It was Dr. Skorin, just entering engineering.

"Who invited you here?" Chad demanded.

"I asked him to come," Debbie said. "We need his input."

"Like hell I do—"

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"Chad!" It was Debbie's turn to be angry. "You're in command. Act like it!"

That brought him up short. "OK," he said. He let out a deep sigh. "OK. Let's get all the cards on the table, though. Chief Merrimack, what do you have in mind?"

"We almost finished the repairs with the remote. If I go in wearing a rad suit, I should be able to finish the repairs before—"

"Before the radiation kills you?" Chad asked.

"*Incapacitates,*" Skorin said. "The chief called me first, Captain. If she can meet her timetable, we can get her out and she shouldn't be any worse off than the men in sick bay. I think."

"What are the men's chances, Doctor?"

"I can't lie to you, Chad. If we get the engines back on line in the next few hours, they all have a decent chance to live. I almost wish I could tell you otherwise. I know what kind of decision this is for you."

Chad turned back to his wife. "And you're convinced the drive can be fixed with only another half hour of work?"

"As fixed as we're ever going to make it."

"Fine," Chad said. "Then these are my orders. I'll go in and make the remaining repairs."

No one spoke. Debbie and Dr. Skorin just stared at him. The others in engineering were silent, too, and waiting. Then Debbie went to a storage locker and pulled out a device, returned to her husband and handed it to him.

"Chad, what is this?" she asked.

He turned it over in his hand, felt the knobs, read the lettering by the dials, and finally admitted he didn't know.

"So you don't know what it is," Debbie said. "If I told you it was broken, how long do you think it would take you to fix it?"

"With you telling me what to do? Not *that* much longer than it would take you, I'd bet."

"Oh, Chad, my heroic fool! You don't even know what this device is. It's a flux leak tracer, a tool. It would take me hours to teach you how to use it, let alone how to fix it. And it's fairly simple."

"But—"

"No, Chad. There's simply no way you can do the repairs. Not in the time we have left."

In anger, Chad threw the tool against the bulkhead. "Dammit! What am I supposed to do? Debbie . . . I can't let you go in there."

"It isn't your decision any more, Chad," Dr. Skorin said, suddenly very stern. "I don't like this anymore than you do, but I'm a doctor and I've got three patients to think about. Your wife has volunteered. She's the only one who can do this job. And the stakes certainly justify the risk. Remember the regulations—Deb meets all the criteria for this kind of hazardous duty."

Chad pulled himself together. Sighed. "I do know the regulations." He turned to his wife. "And if I order the chief engineer not to do it, Dr. Skorin and Mr. Rashid can relieve me

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of command, and you'll go anyway." Debbie nodded, though sadly.

"Fine. But I want a few moments alone with my *wife*. Regulations don't forbid me from trying to talk my *wife* out of something."

They were back in their cabin. He was sitting on the bed. Debbie was naked with her back to him, reaching into the closet for her personal rad suit. Since she was chief engineer, she had her own tailored suit. Chad hadn't objected to her putting it on while he talked to her about changing her mind. After all, she'd pointed out, if he lost the argument it would save time.

He took in the smooth curves, the athletic muscles and sinews, allowing his eyes to flow from her neck down to her feet. He noticed the bruises over the ribs. He paused on her legs, remembering them from only hours before.

Her nudity was only making this tougher.

"But Deb, what if you *die?* I know Skorin says you won't be any worse off than the other three, but they're not in good shape. And if you don't get the drive fixed, then all four of you have had it."

She had the suit in hand now, was performing the ritual of checking its integrity. "Chad, have some faith. If I didn't think that I could finish the repairs, I wouldn't be doing this. There aren't any comfortable options here."

As she turned and bent over to pull on the suit, he glanced at the curve of her belly. Maybe he could see the beginnings of a bulge there; maybe he couldn't. It didn't matter. "What about the baby?" he asked.

She stopped, frozen at the words, and when she finally looked at him, there were tears in her eyes. "You think I haven't thought of that?" she said. She resumed pulling on the suit, not trying to cover up the fact that she was crying.

Chad went to her, put his arms around her, and she clutched at him like a child frightened by the thunder. "Sometimes all of the choices are hard ones," she whispered.

"I don't want you to do it," he said.

She pushed herself far enough away so she could look him in the eyes. "Chad, answer me honestly. If our roles were reversed, and it was your choice to leave me behind and do this, would you?"

For a long time he returned her stare, but he didn't give her an answer.

"That's what I thought," she said.

"Now let me be very clear about this," Dr. Skorin said. "If you stay in there half an hour, you're going to come out very sick. But if we make it to Delta Pavonis, then you'll make it, too. Any longer than that, and there are no guarantees." Debbie simply nodded.

All that was left was for her to put the helmet on. Unlike a normal space-suit helmet, it was entirely enclosed. Two cameras protruded from the face and connected to the virtual reality type eyepiece inside. But what Debbie would be seeing was genuine reality, and not a game.

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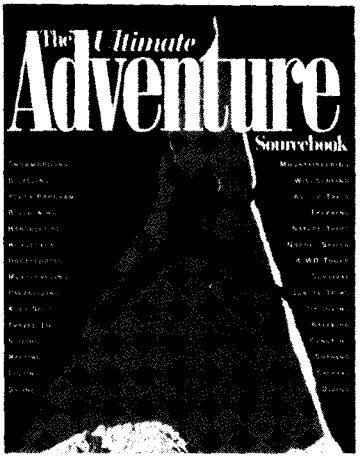

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She held the helmet in her hands and went to Chad. They paused to look at each other, then she hurriedly gave him a kiss. "You come back to me, you hear?" Chad whispered.

"I wouldn't have it any other way," she said. "Now you get out of here, my captain. Your place is on the bridge."

She pulled the helmet over her head, taking a moment to look around and make sure everything was functioning properly. Then she strode purposefully to the hatch and climbed through. One of the engineering crew closed it behind her.

Chad thought it slammed shut with an awfully final sounding clang.

Back on the bridge there was nothing for Chad to do but command.

"Mr. Rashid, stay ready at the helm. I want us in hyperspace the second the chief gives the OK. Three men's lives depend on it." And Debbie's too, he thought. He'd be racing her to the hospital facilities at the colony also.

The whole process was maddening, frustrating. Everything depended on what Debbie did; it was her life on the line, and there was absolutely nothing Chad could do to help her at this moment, but to just wait. " 'They also serve who only stand and wait,' " he thought. He didn't recall where the quote came from, but it sure as hell didn't seem very heroic at the moment.

His memory returned to those moments before the explosion, to his anticipation of the transition to hyperdrive, of the romance and glory of star flight. Again he was waiting for a transition to hyperdrive, but the cast was different, in darker hues, and now the stakes were immediate and high.

Tense, agitated, and vaguely nauseated, at this moment Chad, Captain Chad Merrimack, also felt foolish. All those books he'd read and enjoyed, *Robinson Crusoe, 20,000 Leagues Under the Sea, The Lord of the Rings,* and *Tunnel in the Sky;* he'd thought he was prepared for whatever star travel would throw his way. He knew how the common man hero was supposed to behave.

He'd always felt he'd be able to handle a life and death situation with competence and calm.

If it was his own life at stake.

"Engineering, this is the Captain. What's the status down there?"

"Akiyama here, sir. At last report the chief said she was doing fine. She thinks she'll have us back on line on schedule."

"Good," Chad said. He wanted to talk to her, hear her voice again, convince himself inside that she was OK, but he steeled himself against it. Debbie had work to do; she didn't have time to soothe the nerves of an overly-protective husband.

So instead, he called Dr. Skorin. "You have everything in place down there, Doctor? The second she comes out of the chamber, you'll have her under immediate care?"

"Yes, of course, Chad. I'm not going to let anything happen to her. You just be ready to get us moving when she's done," Skorin said. Chad thought the doctor sounded a little bit nervous, too.

"Captain?" It was Akiyama.

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"Yes?"

"It's the chief, sir. She wants to talk to you. And the Doctor, too. I'll have to patch you in from down here."

"Do so," Chad said, hoping it wasn't more trouble.

"Chad, I have a problem here," Debbie said.

"What kind of problem?" Chad asked simultaneously with Skorin asking, "how much more time will it take?"

"What? One at a time, please," Debbie said.

"What's the problem?" Chad repeated.

"The surge shielding mesh is torn up. There's one section that I can't power up from the main channel. At least, not in the time we have."

"Well, what's the damn thing for?" Skorin asked. "Is it really necessary?"

"It is," Chad said, trying not to betray the emotion rising inside him. "The surge shielding is needed for only a few seconds until the power stream is flowing smoothly. But without it, the conduit will rip itself to shreds the instant we send the virtual particle stream into it."

"We do have one option," Debbie said. "It's dangerous, though. I can energize the damaged section with my tool power pack. But obviously, I'll have to stay with it when we activate the drive."

"What are the chances of it really working, Debbie? The truth," Chad said.

"It will work, Chad."

"Just a minute," Skorin interrupted. "What kind of radiation flux are we talking about now if you stay in there?"

"Worse than we were planning for, Doctor," Debbie said. "But I'll survive. I'm tough."

"Like hell!" Skorin said. "We're cutting awfully close to the margin as it is—"

"And getting closer every minute we waste arguing about it!" Debbie snapped. Then: "It's your decision, Chad. You're the captain."

The most desperate, romantic, and heroic moments are also the loneliest. "Do what you have to do, Deb."

And now he was waiting again, waiting for the word from his chief engineer (it helped if he thought about her that way) that she was ready. They'd have to act fast—the power pack on the tool unit wouldn't keep the surge shielding energized for long. Chad thought about the raw energy that would course up the conduit, the fury of tamed hellfire that would roil and churn so close, ever so close to his wife. There would only be seconds in which to throw the ship into hyperdrive—

"Now, Chad!"

"Now, Mr. Rashid!" *Get us the* hell *out of here!*

Purgatory was a planet larger than Earth by two thousand kilometers in radius, and .12 gees in gravity. It had two polar oceans and one big, volcanic continent that wrapped three-quarters of the way around, like a wide belt cinched on the equator. On any given day dozens of volcanoes might be erupting within the interior of the land mass. The oceans would slosh between the land and the huge

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ice caps clamped onto the poles.

Along the coasts was where the people lived, primarily in dwellings fabricated from the local rock, surrounded by the cactuslike native flora which was Purgatory's predominant native life form.

There wasn't much to recommend Purgatory to the casual star traveler, except that it was an oxygen/nitrogen world where one could walk outside at dusk without a suit and enjoy the sunsets.

And, oh, what sunsets.

The constant volcanic dust gave Purgatory the most spectacular, beautiful, awe inspiring and romantic sunsets in all of explored space. Every evening, fire and rainbows hung like a tapestry in the sky, while the sun set the wave crests afire.

The shores of Purgatory were a land caught between heaven and hell.

This would be a great place to share with someone you love, Chad thought as he walked along that shore.

The *Frisian Sea* had arrived at Purgatory three days before, after spending two weeks out in the Kuiper Belt waiting for the men to get well enough to make the trip to the better hospital facilities on the planet. Chad had given the crew shore leave as his last order as captain, and the ship was awaiting her new skipper in orbit.

Debbie hadn't made it.

It was Chad who had donned the rad suit to go in and bring her body out. He didn't know if she'd lied to him or if she'd just misjudged the radiation levels she'd be subject to when the ship went into drive, but she died very shortly after the transition. He'd found her curled up, looking almost comfortable.

A little note had been fastened to her suit. She must have taken it with her when she entered the chamber, attached it once inside so that if she didn't make it . . .

The words were from a Kipling poem: *If you can fill the unforgiving minute* . . . That was all. But with that she'd said all that needed saying. "Good-bye," "I'm sorry," "I love you," and "I'll wait for you on the other side," all in one.

Chad stood staring out at the roiling waves. He picked up one of the primitive shells scattered about the shore, and tossed it halfheartedly into the surf. He put his hands in his pockets and gazed at the horizon as the wind tousled his hair.

Dr. Skorin found him that way a short time later.

"Hello, Chad," he greeted him.

"Hello, Doctor."

"So what's next?"

"Captain Mulder should arrive in a few weeks to take command of the *Frisian Sea.* I've been placed on leave until I get back to Earth. I won't be going back in our ship."

The two watched the waves in silence then, until Dr. Skorin said, "I didn't know it would turn out this way, Chad. If I'd thought she had anything other than an excellent chance to survive, I never would have let her go. I'm sorry."

Chad sighed, a deep, heavy sigh. Still with his eyes fixed on the water, he said, "She didn't want you to know, Doctor. She didn't want either of us to know."

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"But why? That's what I don't get. No one was asking her to give up her life. Volunteering for fatally risky duty isn't even allowed unless there's a war on."

"She was a romantic, Doctor. What she did was selfless, honorable, in the finest tradition of what it means to be a good human being—"

"That's just it. She was a good person—we could use a few more like her around here. But now she's dead, and your baby's dead, and you're out here miserable!"

Chad gave Skorin an ironic smile. "Did you come out here to cheer me up, Doctor?"

Skorin caught himself, briefly shook his head. "I'm sorry. I'm just angry, mostly at myself."

"I was angry, too," Chad confessed. "But three men are alive now who would have been dead."

"It's not a matter of numbers."

"No. But it is a matter of heart. I was angry, sure. But then I thought about what I would have done, and I would have done the same. I loved her because she was a romantic. Like me. Would I have loved her as much if she hadn't been the sort to sacrifice herself this way?

"Would I have loved her at all?"

The sun sank gently into the water, taking its fire with it, until only a bow of orange and red remained.

"If you're so comfortable with what she did, what are you standing out here for?" Skorin asked.

"Because it hurts, Doctor. It *hurts*." ■

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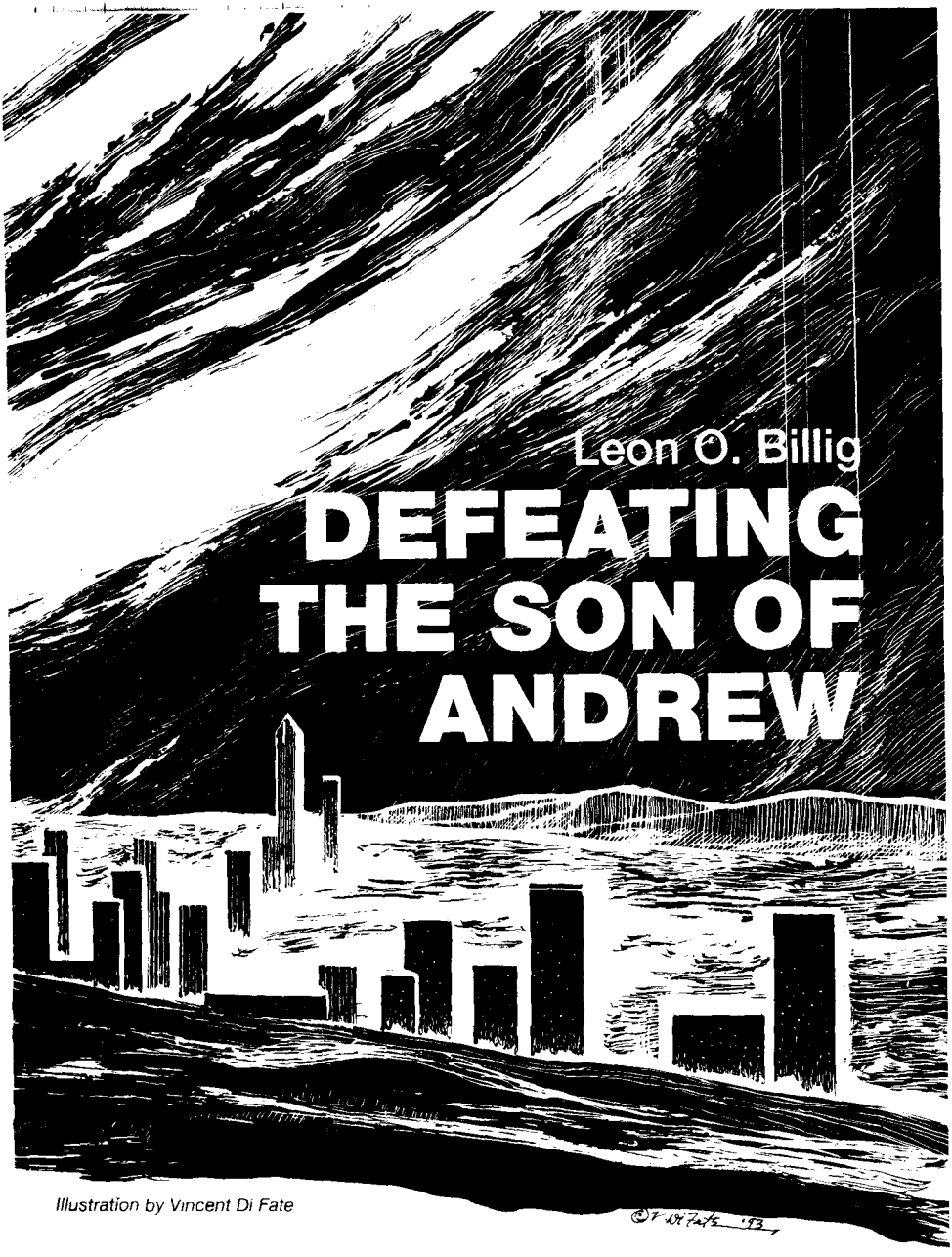

Illustration by Vincent Di Fate

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Hurricane Andrew, which lashed southern Florida during the summer of '92, was the most expensive natural disaster in our nation's history up to that time. While much of the structural damage caused by the hurricane has been blamed on shoddy construction, Andrew's 140-knot winds again raise the question, "Can hurricanes be eliminated?" At the moment, the likely answer is "No." It appears possible, however, even cost-effective, to reduce the damage caused by hurricanes by bleeding off the energy that drives them.

A hurricane is a natural heat engine driven by the energy of atmospheric water vapor that condenses and falls as torrential rain; each pound of condensing vapor releases enough energy to heat 43 pounds of air by 100°F. On a soppy-hot, humid, day (90°F, 90% relative humidity), there is enough moisture in the air (0.0279 lb for each lb of dry air) to raise the temperature by about 120°F if it were all to condense. And much of the moisture will condense if the air is allowed to expand without heat transfer or mechanical losses. As atmospheric air rises, the pressure and temperature drop according to well known natural laws. When the air reaches the condensation temperature of entrained water vapor, that vapor begins to condense into visible drops.

You can demonstrate this effect for yourself with an ordinary garden sprayer. Put a little water into the canister, pump it up as hard as you can, and shake it briskly. Then release the pressure quickly and look inside. The canister will be filled with fog—moisture condensed out of the water-saturated air.

That is how clouds are formed. If cooling continues and the air is turbulent, the droplets will aggregate into larger drops, eventually precipitating as rain. (If the temperature is low enough, the vapor will condense directly into the solid phase and fall as snow, but that does not concern us here; snow is rare in Florida during the hurricane season.)

To develop a strategy for defeating hurricanes, I will describe first the phenomena that allow their energy source, atmospheric moisture, to increase to dangerous levels. Then I will focus attention on the engine itself and cite real-life experience showing that when a hurricane runs out of moist air, that is, when it runs out of fuel, it stops just like any other engine. Finally, I will propose and analyze a scheme to remove atmospheric moisture from the area in quantities large enough to affect the local weather.

As sunlight streams through the atmosphere, a small amount of the radiant energy is absorbed, mostly by water vapor, carbon dioxide, and other airborne contaminants. Air heavily laden with water, whether in vapor form or in clouds of tiny droplets, will absorb more energy—and thus be warmed more—than pure air. The remainder of the energy strikes the surface of the Earth where most is absorbed. (A small amount is reflected back to space.) If the sunlight strikes land, the ground is quickly warmed,

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warming the adjacent air in turn. Bubbles of warm air soon break away from the surface and rise as "thermals." As the thermals rise, the air expands and its temperature drops until its density matches that of the air warmed by direct sunlight. Each summer thermal will likely be capped by one of the puffy white clouds so beloved of poets and painters. But unless the air is very moist, the amount of energy released by condensation will be too small to affect circulation significantly.

If the sunlight strikes water, the energy will be captured by the top few feet. Since it takes a lot of energy to warm water, its temperature will rise less than that of land. While the air at higher altitudes is warmed slightly, the air near the surface remains at nearly the water temperature, causing a temperature inversion. Eventually the water is warmed, and as its temperature rises, the vapor pressure at the air-water interface also rises. Some of the water evaporates into the atmosphere, keeping both water and air too cool to break through the inversion layer. But the air at low elevations becomes loaded with moisture.

Water has the highest heat of evaporation of any known substance, and the moisture capacity of air—and hence its energy capacity—increases rapidly with temperature. Soon the moist surface air has enough energy, if released, to rise like a land-based thermal if only it could break through the temperature inversion layer. That energy will be released when the moisture condenses to fall and rain.

By the time the surface air over tropical seas is warm enough to rise in an updraft that can break through the temperature inversion, the energy concentration will have risen to dangerous levels over huge areas. Once the inversion layer is penetrated, condensing moisture releases additional energy, accelerating the updraft. The process runs away; the updraft will build in intensity as long as its supply of water vapor continues to expand. The sea-level barometric pressure drops sharply. The resulting low pressure system sucks in moist air from ever increasing distances. When the distances become large enough that the rotation of the Earth becomes a factor, the storm begins to swirl (the so-called Coriolis effect), stabilizing the flow and allowing the local pressure to drop further. Wind velocity rises and a hurricane is born.

The newly hatched monster wanders across the face of the Earth seeking moist air on which to feed and grow. As the barometric pressure drops in the path of the approaching hurricane, the temperature follows. Moisture starts to condense and release energy that reheats the air. The reheat reduces the air density and further depresses the local barometric pressure. The hurricane will be drawn in the direction where the release of moisture was greatest, i.e., the direction in which there was the most moisture to begin with, turning away from an area covered by dry air, where the pressure drop is smaller.

Deprived of water vapor, a hurricane dies. This was demonstrated a few years ago when a hurricane that had devastated Jamaica headed for

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Texas, which was at the time suffering a severe drought. Texans resigning themselves to extensive wind damage took comfort in the expected break in the drought. When the hurricane approached the Texas coast closely enough to suck in the drought-parched air, it suffered terminal indigestion, splitting into two disturbances that petered out without touching land. Texas suffered no wind damage, but had no rain either; the drought dragged on.

And after Andrew devastated Florida and headed across the Gulf of Mexico, large sections of southeast Texas were evacuated, and people hunkered down for a blow. But an unseasonal cool front had just covered the state with dry air. Andrew turned north, away from Texas, and died shortly after striking the Louisiana coast. The relieved Texans did not even get any rain.

We thus have empirical evidence to support theory indicating that hurricanes avoid areas covered by dry air.

As to whether the hurricane goes somewhere else or stops being a hurricane, I can only cite the two cases described above. The dividing and subsequent death of the hurricane that devastated Jamaica was dramatic. In the same way, Andrew was headed straight for southeast Texas when it suddenly turned inland at the Louisiana coast and died. In each case, the air over Texas was unseasonably dry. This, too, suggests that hurricanes tend to move in the direction of the greatest atmospheric moisture. If the beast cannot find enough energy to survive, it will die. In the two cases cited, it turned and it died.

According to this logic, all we have to do to provide protection against hurricanes is replace the local moist air with dry air. And how do we provide dry air? By providing an artificial mechanism that allows the moist air to break through the inversion layer. This will suck off the moist surface air and replace it with dryer air from higher elevations.

Once the inversion layer is penetrated, condensing water vapor will provide the energy to keep the process going. It is easy to start an updraft with a large gas flame. The challenge is to keep the air at the inversion layer from mixing with, and pinching off, the stream of rising moist air before the entrained vapor condenses and releases enough energy to continue the process. This can be done by enclosing the column of rising air in a tall—a *very* tall —tower or chimney large enough to carry huge quantities of air high enough for a significant part of the water vapor to condense.

In exploring the feasibility of such a project, I established a baseline requirement: The installation had to operate with a sea-level atmosphere of 85°F and 80% relative humidity. This is considered mild summer weather on the Gulf Coast. (I have seen a strip chart recorded at Lake Houston showing only a couple of blips where the humidity level dropped below 100% for a few hours in a two-week period.) If there were no condensation and no heat transfer,

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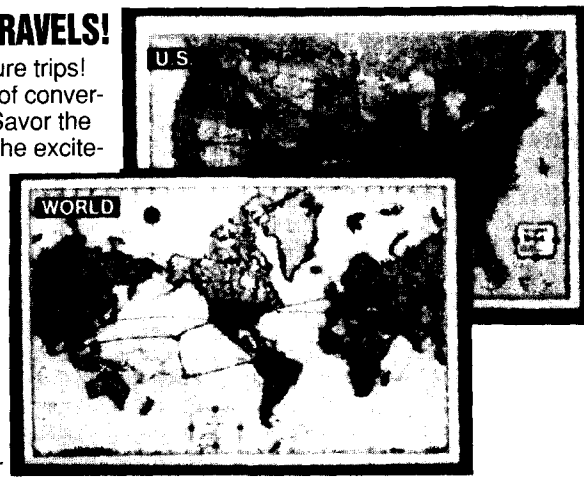

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the temperature of the air rising from sea level to the top of a chimney 6 kilometers (or 19,685 ft.) tall would drop from 85°F to −21.8°F. (Most of my reference books used English units, so I did too.) But moisture would begin to condense long before the air got that cold. Of the 0.021 pounds of water vapor entrained in each pound of air at sea level, 0.0125 pounds would condense by the time it reached the top of the chimney. The vertical velocity at the top would be 298 feet (90.7 meters) per second, while the air exit temperature would be about 33.6°F. This temperature suggests that if the chimney were much more than 6 kilometers high, de-icing would be required on all but the hottest, wettest days.

At this point we have to leave the comfort of thermodynamics textbooks for the real world. When I approached Stan Schmidt with the idea for this article, I stipulated that the proposed project would use current technology with modest, predictable improvements in metallurgy, construction techniques, etc. Having determined that the chimney would operate during most of the southern-U.S. summer, I turned to the next questions: Can a structure 6 kilometers tall be built strong enough to withstand anticipated wind loads without the use of "unobtainium"? How large must it be to mitigate hurricanes? Can the nation afford it?

I assumed the structure would be built of steel alloy, density of 490 lb per cubic foot, and allowable stress in compression of 60,000 psi. A uniform steel cylinder 6 kilometers high will generate stress of 67,000 psi in the material at the bottom, a bit more than three times the level permitted in mild steel structures under most modern building codes. That would be no problem in the absence of wind loads; the material will be in compression rather than tension, and modern commercial alloys can tolerate far higher stresses than mild steel. Furthermore the cylinder walls can easily be made thicker at the bottom to reduce the stress. But until real-world experience shows that hurricanes can indeed be mitigated, every structure built in Hurricane Alley must be designed to withstand them.

Predicting loads is frequently the most difficult part of any structural design problem. Building codes incorporate cook-book formulas based more on experience than analysis. Aircraft designers build structural prototypes and test them to destruction. Marine architects designing offshore racing sailboats have rules of thumb based on their experience and the daring (some would say foolhardiness) of the skipper-customer. But an engineer designing chimneys 6 kilometers tall has neither building codes nor experience to guide the design process. Nor is it practical to build a prototype to test to destruction. I had to set my own design criteria.

Gusts reportedly reached 140 knots during Andrew. It is unlikely that all of a 6-kilometer-high structure will see such gusts at once, however. Furthermore, measurements made over Green Bay, Wisconsin in April,

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1962, showed that wind direction can vary by 120 degrees over 6 kilometers in elevation. Based on these considerations, I set the design level at 135 knots (226 feet per second).

Sea level pressures on the order of 85% of normal atmospheric pressure are commonly measured in the eyes of hurricanes. (If some people feel out of breath during hurricanes, there is a good reason for it.) I have no hard data on the relation between barometric pressure and elevation in a hurricane, but Blevins, my primary reference for this article, has a chart (p. 416) showing a velocity-time trace recorded during the passage of hurricane Celia over the recording station at Gregory, Texas, 12 miles northeast of Corpus Christi, on August 3, 1970. The chart shows a fairly steady increase in velocity to peak gusts of 138 mph just before, and 134 mph just after, the eye of Celia passed. Since the extremely low pressure in the relatively calm eye is balanced and maintained by the centrifugal force of the surrounding wind, that low pressure region must extend upward as far as the hurricane-force wind; if the wind drops, the pressure will promptly revert to normal and dry, upper-atmosphere air will spill unhindered into the eye, causing the hurricane to unwind. Hence I assumed the pressure to be 0.85 times that of the U.S. Standard Atmosphere at all elevations.

The column of warm air rising from the eye must extend at least to the tropopause, which is far higher in the tropics than at temperate latitudes. I therefore used 27°F (15°C) above the standard day value to calculate the outside air properties at each elevation. This assumption is undoubtedly conservative. The amount of latent energy released during torrential rainfall over a large area is staggering.

These two assumptions reduced the computed ambient air density at all elevations—and wind loads on the structure—by almost 20% compared to those computed using the standard atmosphere.

Next I had to select a value for the drag coefficient, the parameter relating the force of the wind to the load on the structure. Literature on fluid mechanics shows the drag coefficient to be around 1.0 for small cylinders (low Reynolds numbers). It drops to a minimum of 0.4 for Reynolds numbers of around one million, then gradually rises again to around 1.0 as the cylinder becomes very large. This rise in drag suggests that the thickening boundary layer causes large areas of separated flow on the lee side. I assumed that boundary-layer-control devices, probably fixed vortex generators, could suppress the flow separation, keeping the drag coefficient to 0.4. Of the assumptions made in the analysis, only this one cannot be shown to be conservative.

The design requirements are summarized in Table 1.

The next task was to select a configuration. Both intuition and analysis indicate that a tall, large-diameter chimney will withstand wind loads better than a tall, skinny one. In fact, for a given wall thickness, doubling the diameter will reduce the stress by half, even allowing for the greater

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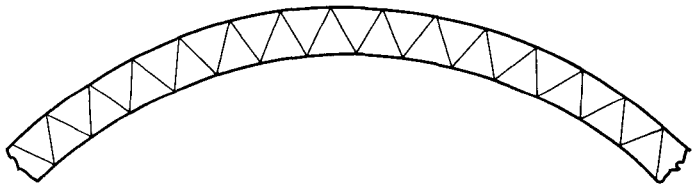
TABLE 1: STRUCTURAL DESIGN REQUIREMENTS

Chimney height	19,685 feet (6000 meters)
base diameter	5000 feet (1525 meters)
top diameter	2000 feet (610 meters)
material	steel alloy, density 490 lb/cu ft, allowable compressive stress 60,000 psi
design wind velocity	135 knots (69.45 meters/sec)
drag coefficient	0.4
double-wall construction with accordion-pleat stiffening	

Figure 1: Cross section of a section of the chimney wall showing the accordion-pleat circumferential stiffening.



area, and wind load, associated with the larger diameter. Tapering the structure will also help. I arbitrarily set the diameter to 2,000 feet at the top and 5,000 feet at the bottom. While using thin-wall cylinder equations in the stress calculations, for circumferential rigidity I postulated a double-wall structure with accordion-pleated webs connecting the inner and outer shells. (See Figure 1.) These accordion pleats can support their own weight whereas the more conventional circumferential stiffening rings would have to be supported by the cylinder walls.

For analysis, I divided the structure into six segments, each 1,000 meters tall, and set to work. Starting at the top, I calculated wind and structural loads on each segment in succession. At each step below the topmost, I included the wind loads (moments) and the weights of the higher segments.

The loads on the top two segments proved to be so small that the minimum gauges would be likely set by the fabrication and assembly requirements rather than by stresses. Hence I selected an effective thickness of 6.5 mm for these segments, the thickness to account for both the inner and outer shells plus the accordian-pleat stiffeners. For the third segment and to the bottom, the effective wall thickness required to accommodate both wind loads and structural weight without exceeding the design stress was based on calculations. Each section was assumed to be of uniform thickness over the entire 1,000 me-

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ters. This is heavier than necessary but it permitted a closed-form solution for the thickness, and it is conservative. In the real world, wall thickness would be adjusted at intervals of less than 1,000 meters.

Sections of the structure would be fabricated on the ground, heat treated if necessary, and the finish baked on. Then they would be hoisted into place and fastened mechanically, with bolts or rivets.

The results of the design computations, summarized in Table 2, indicate that the total weight would be almost 2.7 million tons, a significant portion of the U.S. total annual steel output but not impossible. According to the *1993 World Almanac*, the 1980 U.S. output of raw steel was 111,835,000 tons. By 1991, the output had dropped to 87,896,000 tons, with a drop of more than 11,000,000 tons from 1990 to 1991 alone. Large mills are being shut down while more efficient mini-mills with electric furnaces are coming on line. (Steel makers think big; a "mini-mill" may have a capacity of two million tons per year.) Under the circumstances, it appears that the U.S. steel industry could support indefinitely the construction of at least one chimney per year. This is especially true if experience shows that a chimney significantly reduces the peak local wind velocity—a condition that must be met if the installation is to be cost effective—and requires less steel.

Since the crust of the Earth might be unable to support a concentrated 2.7 million-ton load, an equal weight of earth would have to be excavated and removed from the immediate vicinity. The required volume, at 2,500 pounds per cubic yard, would be 2,152,000 cubic yards. The circumference of the base of a round chimney 5,000 feet in diameter is 5,236 yards. To remove 2,152,000 cubic yards of earth would require a trench with a cross section of 3,700 square feet. Think of it as a trench 100 feet wide and thirty-seven feet deep. We have all driven through freeway cuts far more impressive. The sides would of course be sloped so that the bottom would be perhaps fifty feet wide,

TABLE 2: WALL THICKNESS AND WEIGHTS

Segment	Wall thickness	Weight
Top 1000 meters	0.250 in (6.5 mm)	118,340 tons
2nd 1000 meters	0.250 in (6.5 mm)	144,350 tons
3rd 1000 meters	0.343 in (8.7 mm)	234,250 tons
4th 1000 meters	0.532 in (13.5 mm)	450,000 tons
5th 1000 meters	0.768 in (19.5 mm)	686,500 tons
6th 1000 meters	1.057 in (26.8 mm)	1,055,900 tons

TOTAL WEIGHT 2,689,600 Tons (1,881,000 Tonnes)
COST OF STEEL @ $500/ton $1.345 billion
Volume of earth to be removed (@ 2,500 lb/cu. yd.)
to balance weight of the structure on the earth's crust:
2,151,700 cu. yds.

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and the top, 150 feet wide. Some additional native material would be displaced by a concrete footing and retaining wall.

These results of this design study strongly suggest that the proposed structure is technically feasible with today's technology. While the effectiveness in abating hurricanes cannot be predicted without more data, it is reasonable to expect some benefit. Although the benefit may not be directly measurable, draining more than 2,800 square miles of humid air every day to a depth of 500 feet has to have some cumulative effect. If the structure had been in place and Andrew had had 120-knot winds, many people would have pronounced it a failure. There would have been no way to know that without it, winds would reach 140 knots, increasing wind loads by 36% and vastly increasing the damage.

No more than one chimney can be justified until experience verifies the concept. The first could be sited where Andrew did the most damage—south of Miami. Since hurricanes generally move north and west, logic suggests the chimney should be southeast of the area to be protected. The first, and probably subsequent, unit should be in an unpopulated safety zone with a radius at least equal to its height, in case the thing should blow down.

After the concept has been proven, siting density should reflect the exposure to hurricane damage. West of the Florida peninsula, a single installation might be adequate to protect Pensacola and Mobile, another to protect New Orleans, one for the Houston/Baytown/Galveston area and possibly one more to protect Corpus Christi/Freeport. A string of five between Miami and Cape Hatteras, one each sited near Orlando and Jacksonville, Florida; Savannah, Georgia; Charleston, South Carolina; and Wilmington, North Carolina would protect major populated areas on the southeastern U.S. coast. I don't recall hearing of extensive damage north of Cape Hatteras since the hurricane that hit Boston in 1938.

Guide vanes would be installed at the bottom of the chimney, where the flow enters, to cause the air to swirl and throw the condensate against the inside walls, to be collected in gutters. This water could be diverted to human use, replacing expensive ground water and easing the stress on the environment. Collecting the water high inside the chimney and running it through turbogenerators on its way to the ground would generate significant quantities of electrical power. Thus a hurricane-abatement chimney would also yield significant near-term economic and environmental benefits to help offset construction costs. These benefits are included in Table 3, Predicted Performance.

Virtually every large metropolitan area can use an additional five or six billion gallons of pure, fresh water daily during the summer months. At the modest price of $0.10 per thousand gallons, this would bring in $500,000 to $600,000 every day. The high purity of this water compared to surface supplies would generate fur-

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TABLE 3: PREDICTED PERFORMANCE

QUANTITY	85 F,80% rel humidity	90 F, 90% rel humidity
Air temperature at the exit	33.5 F	45 F
Air velocity at the exit	298 ft/sec.	350 ft/sec.
Airflow at sea level, trillion cu.ft./day	41.35	47.06
Radius of circle of air drained daily to depth of 500 feet	30.73 miles	32.78 miles
Water recovered, billion gals day	4.53	5.775
Waterpower, gigawatts*	5.936	7.57

*Assumes water is collected at the 10,000-ft level and run through perfect turbines (efficiency 100%) driving perfect generators.

ther cost savings; about the only contaminant would be a few million mosquitoes sucked in daily with the air. (Since the velocity of the air approaching the base of the chimney would be modest outside the unpopulated safety zone, it is unlikely that the local mosquito population would be reduced enough to include abatement as a side benefit, however.) A reduction in atmospheric humidity would reduce air conditioning costs.

Probably the greatest side benefit would be the electrical power generated. A few extra gigawatts of pollution-free power (no smoke, no ashes, no carbon dioxide, no nuclear radiation, no waste heat) are always welcome in any urban area, even if available only during the summer. At a wholesale price of $0.03 per kilowatt hour, this power alone would be worth more than $5 million per day during the summer months when the chimney operates. This is the period of peak summer electrical loads, when air conditioners are cranked up to the top.

The very height of a 6-kilometer tall structure could be exploited commercially. From the top, the horizon is 160 miles (277 kilometers) away, far enough to make any television broadcaster drool. Radar mounted at the top would provide the equivalent of a fleet of AWACS planes flying twenty-four hours a day. (Smugglers, look out!) Finally, condos mounted on the structure at the 5,000-foot level might find a ready market in the Miami area. The view would be unprecedented and the air fresh, while the temperatures at that level would allow comfortable summers without air conditioning. All these appurtenances would add cost and weight, but the increment would be comparatively modest.

I have made no effort to estimate construction costs beyond the cost of

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the steel. There are several reasons for this. First, I am not a cost estimator. Secondly, the cost is in the details, and there are no details. No effort was made to optimize the structure. Finally, if construction costs are hard to estimate, estimating the legal fees is worse. In our current political climate, there would be more lawyers than engineers involved in the project. Let us say that the construction cost might be about the same as the cost of two aircraft carriers fully equipped and manned, or the cost of developing a totally new large jet transport. Maybe $15 billion. The legal and political costs might be about equal to those of a U.S. presidential campaign. To offset these costs, annual revenues of around $700 million from the sale of fresh water and electrical power can be projected during the 120 days of peak summer heat and humidity. Concomitant but unpriced environmental benefits would include reduced pollution from power generation and less strain on fossil-fuel and ground-water resources, as well as reduced wind and flood damage from rampaging hurricanes.

I leave it to the reader to judge whether the projected benefits outweigh the costs. ■

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ABOUT THE AUTHOR

Leon Billig was born and reared in Hurricane Alley. One of his earliest memories is of a night of howling wind and torrential rain rocking his parents' home on the Texas Gulf Coast. His interest in hurricanes was sharpened by the experience of riding out a typhoon off Okinawa in a World War II Liberty ship. After a stint in the construction industry and a tour of military duty in Korea, he turned to aerospace engineering, where a specialty in the thermofluid sciences lends itself nicely to the analysis of hurricanes and related atmospheric phenomena.

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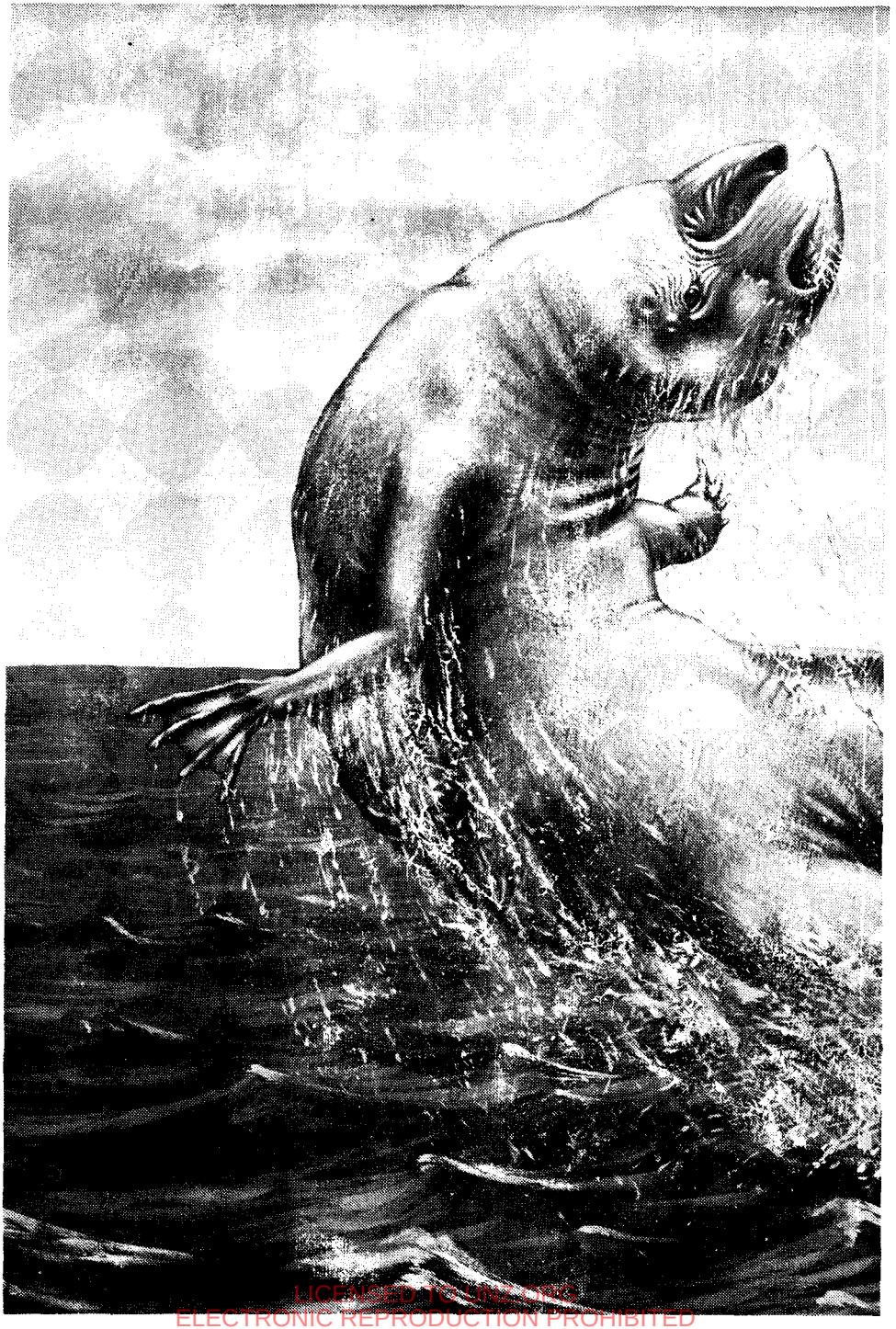

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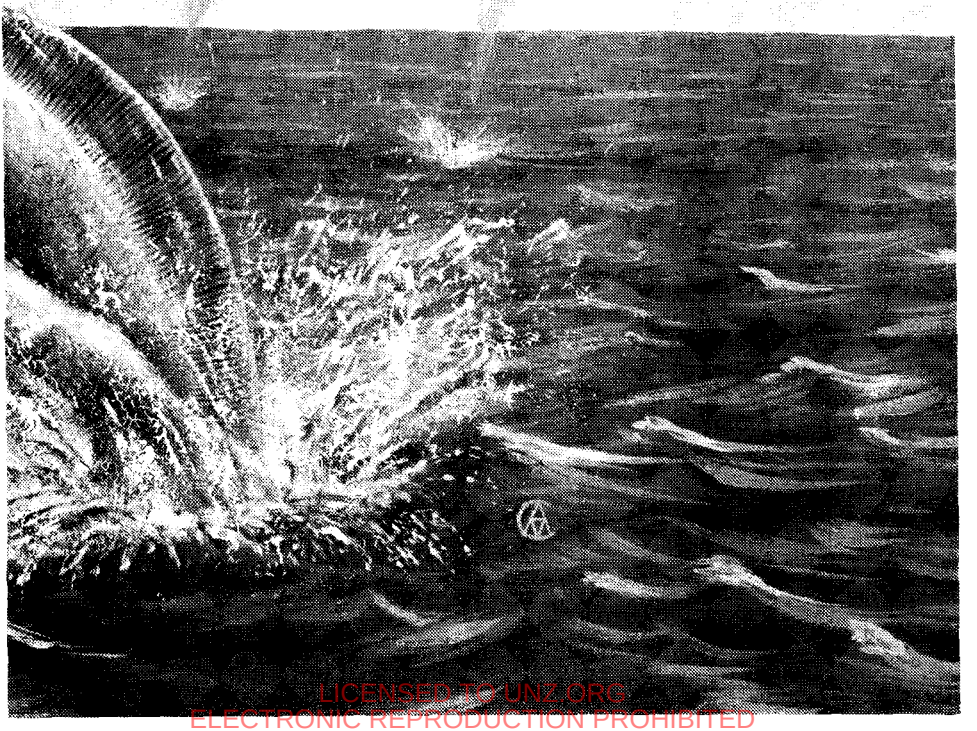
G. David Nordley

NETWORK

It's not easy for three species to share a world. A common enemy helps, but they still must contend with their own complex natures. . . .

Illustration by Alan M. Clark



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Neither forcible reeducation of citizens who have chosen to leave civilization, nor the effects of the unchecked expansion of their low technology communities is consistent with Trimusian values. Therefore, the Trimus Planetary Council hereby approves and directs the transportation to Aurum III of such residents of the Trimus natural reserve regions who do not voluntarily opt to accept and behave according to the environmental and social restrictions of the Compact and Charter of the Planet Trimus. The Aurum III planetary bioforming project will be redirected toward this end.

—Signed 4704 TF: Bo Flor,
Kleth/Karen Olsen,
Earth/Gori'allolub, Do'utia

The severed head of a Kleth scientist, displayed with other evidence in a transparent case in the lobby of the presentation dome, set the mood for the gathering in the Trimusian capital, Triapolis. Lieutenant Drinnil'ib of the Trimus Planet Monitors looked at it with forensic curiosity and over half a macroyear's experience. The eyes were unusually far apart, almost half a doci, for a Kleth, and the two notches in the Kleth's crest signified a warm weather birth; a congenital feature, if Drin remembered correctly. *A wonder of the universe that that tiny skull had contained a brain as powerful in life as his own.* The plumage had been black, with the sun-bleached tips of a field worker, or avian athlete.

Drin settled himself down on a free pad. A human about one-sixth Drin's length, probably Councilor Karen Olsen, sat on the edge of a pad three aisles down. A fellow Do'utian male had settled in comfortably far behind and to his right; it was Councilor Gori'allolub, Monitor General, smelling grim. His tail hung over the standard charter unit length pad. Likely eight-squared and six doci's. No one, Drin thought, cast votes based on size, but, somehow, the big bulls often rose to the top. Drin waved the top of his own, somewhat shorter, tail in respectful greeting to the other Do'utian. Other humans and Do'utians occupied other pads, but no Kleth were to be seen. Such meetings were not their style.

The ready tone echoed across the roomy dome soaring three charter units above him. On Trimus, humans got their pronounceable language, Kleth got their convenient octal numbers, and Do'utians got room to breathe. Drin blinked to look at the sonic afterimage and sensed the different textures of the surfaces; hard bright arching ribs above with deep black between. When he opened his eyes, for all appearances the dome was now transparent, and he was eavesdropping on an Aurum III biological team, eight-squared days ago, near a bioforming station on a northern island. The sensors had been set up to monitor animal behavior in the station area—and they may have done just that.

A human and two Kleth were in the area.

"So they're coming *anyway*," the human, biologist Theric Soames, remarked.

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Drin judged the inflection of Theric Soames's voice as hostile, and swiveled an eye toward Councilor Olsen, a firm advocate of resettling the primitives. She showed no reaction to this opposition but then Drin wouldn't have expected her to show surprise as freely as her daughter, his Monitor colleague Mary, and many subtle changes in humans were mysteries to him. But he knew there was substantial human opposition to resettlement, both from fatalist liberals willing to let things evolve as they would, and hard-beaked conservationists like himself.

"I knew it but I didn't want to believe it," Soames continued. "The council is going to turn two centuries of work, a whole new planet, over to irresponsible children."

"We not design Aurum III from start for primitives," a Kleth remarked, looking up from her seedlings. Ko Kor was her name, Drin remembered; wide-eyed, smooth crested, and gold tinted.

"No. But we adjust. Some chance now," her mate answered. That would have been Sha Ton. Drin knew the head; the rest was a large, nearly human length male whose sun-frosted black coat gave him an almost spidery look.

"It's premature," Soames said. "We still had a lot to learn from our original ecological design."

"Like Kleth monkey-bats and Earth pine cones," Ko Kor boomed in accord. "If works, maybe help reforest Southern Islands on Trimus after primitivists gone. Monkey-bats good eating, too."

Drin sympathized. He still felt outrage at what the polluting primitivists had done to some of those islands in the areas of Trimus that were supposed to have been left alone.

"Oh, yes," Sha Ton concurred with his mate. "Lunch time. Got some for Theric, too."

The Kleth leaped into the air and with strong wing-beats sped toward the station.

"Hey, wait a minute," Soames yelled. "Stay out of my food; I'll get it later." Desperately? Drin wondered.

The station, a geodesic dome, was tiny by the majestic Do'utian-compatible standards of the capital city, but it was meant only for Kleth and human. A circular patch appeared in a pentagonal panel halfway up. A loud, startling crash came next, faithfully reproduced.

Sha Ton back-winged in surprise and hovered over the collapsing building in the smoke.

Another hole appeared closer to its top, with even a louder noise. There were sparks from severed power leads and a fire started. Debris flew and spots of grass started steaming here and there.

And, for no reason anyone could see, Sha Ton's head fell off. His wings continued to beat once, twice. Then his body, no longer knowing what to do, simply fell through the hole into the fire.

Ko Kor screamed and launched herself after her mate.

The human grabbed for her and got a leg in his hand. She slashed a claw at it, knocking it off.

"My life is in there!" Ko Kor

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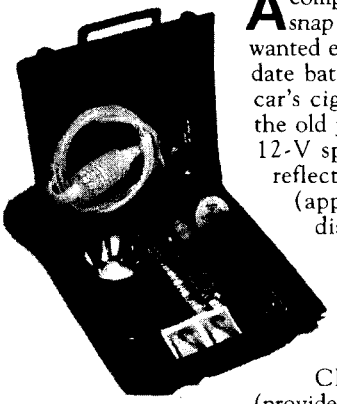

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screamed and flew at the building, diving into the flames.

The human stared at his bleeding arm. A biologist, Drin thought, should have known better than to try to keep half a Kleth team alive. Soames vanished from view and the scene showed smoking wreckage for a minute, then faded to gray.

If there were any clue in this, Drin didn't recognize it. He gave a low rumble of frustration, pushed his massive frame off the pad, and turned to face the Councilors, already discussing the crisis. The human Councilor, Karen Olsen, looked at him and opened her mouth as if to say something, then appeared to change her mind, shaking her head. She nodded to Drin and left, giving Gori'allolub a respectful pat on a leg as she went by; friends on opposite sides of a very complicated issue.

The Do'utian Councilor dipped his beak to the departing human and approached Drin.

"Lieutenant," the Councilor intoned with full authority. "I know your views."

Drin dipped his beak in assent. There was no need for Gori'allolub to tell Drin what low tech population pressure was doing to the reserved area of Trimus, nor of the reluctance—misplaced in Drin's mind—to reeducate the polluting idiots.

"But I also know your intelligence and your dedication to our civilization. We felt it best that a Do'utian be in charge of the investigation. Also, for impartiality's sake, it does not hurt that the most likely suspect be pursued by one of similar bent on this issue. The focus must be on the deed, or accident, not the politics. Your answers will have more credibility among the opposition. There must be a solution that strengthens our unity, not divides us."

"Agreed."

"The human, Soames, has disappeared. The rest were evacuated. You will be the first Do'utian to visit, in person, a world built in part for Do'utian settlement. That is a historic responsibility."

And a historic adventure, Drin thought. There was no elevator down to Aurum III—it spun too slowly—so he would command the first Do'utian landing-craft built in several macro-years. A tantalizing fore-scent of virgin beaches and unhunted seas wafted through his mind.

"I am ready for the challenge."

"Good. The schedule for resettlement of the human and Do'utian primitivist populations depends on your success." The Councilor hesitated, then asked, "is your life complete?"

So the Councilor thought he faced more than normal danger. Drin raised his beak, and opened it slightly; a Do'utian ready for anything. "Nothing of consequence is undone."

"That is best. In such a case, sacrifices are sometimes needed. Those are troubled waters, Monitor. Go quiet them if you can."

Lieutenant Drinnil'ib touched his beak to the floor, accepting the duty.

The base mass unit of Trimus shall be the "dom," the mass of a cube of water one doci-charter unit (1dc),

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10^{-2} charter units (cu), (8^2cu base twelve or ten) on a side, at maximum density. Equivalent units are: Kleth, 102 eggs; Earth, 3.68 (base ten) kilograms; Do'utia, 1.07×10^{-5} (base twelve) cube. Subordinate units shall be derived from basic physical formulae. A cue (charter unit of energy), for instance, is one dom-cu^2/beat^2.

—Compact and Charter of Planet Trimus, Technical Appendix

The English prefixes "macro" and "mini" shall have specific meanings in the octal numeric system of Trimus. Macro shall be used for an exponent of three, and mini for an exponent of minus three. For larger triads, the prefixes di (2), tri (3), and so on may be added and the last syllable dropped. Thus the prefix for 10^6 shall be "dima," and for 10^{-6} shall be "dimi." This is exactly analogous to the Kleth suffixes ¥ and ¥i, as used in "no¥*" (10^6), and "no¥i" (10^{-6}).*

—Compact and Charter of Planet Trimus, Language Appendix

Gradually, pronounceable Kleth and Do'utian words—or direct translations such as "cube" slip from Do'utian for cubic tail, or no no, from Kleth for 10^{-11}, penetrated Trimus English. Also, some human decimal and even more ancient duodecimal words, such as "century" (144 years) or "dozen" (14 of anything) that worked in other cultures—continued to be used.

—Go Zom's notes on the Compact of Trimus

Spacecraft work was painstaking, but experience had shown that a second set of eyes, and a mind that swam in different seas, often saw things other minds did not. Also, in the tradition of Do'utian space voyagers, Drin intended to know his ship. It was, in essence, a steam rocket with an exhaust velocity of eight-cubed charter units per beat. Water was stored in the great tank that also served as Drin's quarters. It was pump-fed through antihydrogen mass converters to make steam, each converter a porous bed of very high temperature refractory alloys that surrounded an annihilation chamber.

The *Egg* contained half a minidom of antihydrogen ice, distributed among three eights of electrostatic dewars. He intended to check the quintuply redundant isolation and feed systems on each of them. These systems had to store the antihydrogen and deliver it to the annihilation chamber in near perfect isolation from the world of ordinary matter. But near-perfect, for Drin, meant a leakage rate that would be fatal to his Kleth and human partners. Do'utia was young for a life-evolving world and natural fission reactors were an occasional and unremarkable feature of its geology. Scale and opportunity had dictated that Do'utian space flight had been nuclear powered from the beginning, and experience made their designs the best in the known universe, if the criteria were performance.

But he had to meet human and Kleth safety needs here, and wanted to be absolutely sure.

An underwater hatch cycled, clanging in the back of Drin's consciousness, so he was not completely

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surprised when human Monitor Mary Pierce swam up beneath him and pulled herself onto his back. "Welcome, little one." Out of view to even his swiveling, bifocal eyes, she was a nice warm spot on his neck. "Our ship looks very sound so far."

"Oh it's good to see you, Drin. What a relief!"

"How did the negotiations go?" She had just returned from duty with the team informing the largest of the human primitivist communities of their imminent relocation, and trying to secure their voluntary cooperation. It didn't take a marine biologist to tell him the short answer was "not well."

"Not well. One self-styled Lord Thet is still having the time of his life and doesn't want to budge, and his primitive empire is growing despite everything. He even objected to our taking some people he'd enslaved back with us."

Unlike Kleth and Do'utians who, unless maimed, could eat off the sea and fly or swim around the planet, humans needed technology for transportation. And their primitive alpha males controlled all the transportation from their stinking settlements. Eccentrics and idealists living alone or in small groups on the tropical islands around the inner Pole had been captured, and, having abandoned their links with Trimusian civilization, had found themselves having to play slave or starve.

Drin fumed. "That idiot has 3 percent of the human population of Trimus and is producing 30 percent of the effluents—untreated sewage!—in an area that's supposed to be completely free of such things. One can't even swim near his area without having tongue stunk, eyes stung, and starving for lack of anything uncontaminated to eat!"

"They're certainly a much worse problem than the Sea Lords," Mary sighed.

"Bah! Reeducate those thoughtless, live-for-today hedonistic buccaneering beachmasters too!" he grumbled. Human degenerates were one thing—he could look on them from an analytical distance, but mention of the renegades of his own species touched a nerve. Slavery was mild compared to what the rogue beachmasters had done to their often unsuspecting harem recruits. "What do you think will happen in a few macroyears when this mindless interspecies Petri dish we are creating on Aurum III boils out into the rest of the universe?"

"Drin, some feel we've solved too many problems for our own good on Trimus. Eternal lives of cyberservant-supported study and art just aren't stimulating enough for some of the people our biology produces. There needs to be an outlet for this, but we shouldn't have to live with their consequences. So, according to the Council, they get their own planet, to relearn all the lessons the hard way. Speaking of eternity. I could lie on your nice soft blubber forever, but," she climbed to her feet, "I need to prep the upper decks for me and our Kleth partners."

"Yes. I'll do the visual on the hull while you check the penthouse."

He helped her up the ladder, dove

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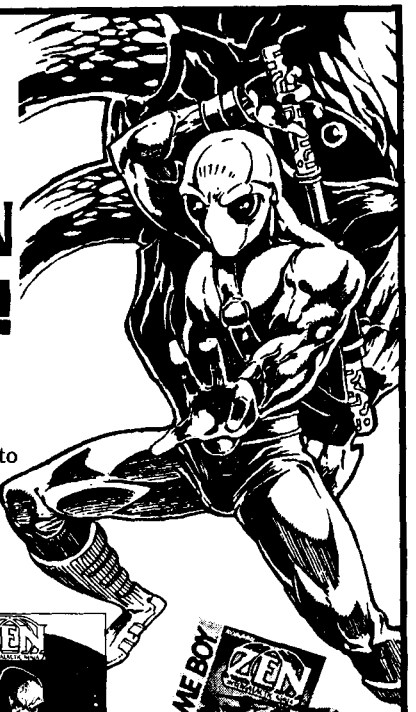

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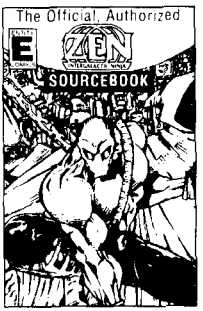

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below, through the waterlock and into the sea. It was a warm day near the inner pole, the great crescent of infrared Ember hot under the disk of gold-tinted Aurum.

It was so enervating that he lost his concentration and almost missed it: a clogged exhaust vent; a dark spot in audio where the others shone like regular rows of stars. The ship hadn't reported it.

"System B, code 73147," he sent immediately, ordering a wholesale system swap. Meanwhile, three beats of his tail got him up to the fouled vent.

It looked almost like a spiderstar nest; the seaweed and muck inside hadn't grown there—someone or something had deliberately filled the vent with debris.

"Code complete," the ship confirmed. "We have a blocked vent, ordinal 3472—"

"I have it and am cleaning it," Drin interrupted. "Why didn't your predecessor see it?"

The answer came with cybernetic speed. "My predecessor was instructed to ignore it by an authorized maintenance simulation command that stayed in the command register, and so didn't show up in the discrepancy checks."

Drin growled at a frequency that caused the hull to resonate. "What's the status on the other command registers on the A side?"

"Clean now."

Drin hated himself for what he had to ask next, but the logical suspicion had to be removed.

"Check the source of the anomalous command. Code 72537, Commander only. Check against Planet Monitor Mary Pierce for code, voice, and date."

"The code matches but not the voice, and the date was 124.2." So someone other than Mary had gotten Mary's access code and, ten days ago, inserted a highly technical and innocuous command that allowed whoever had clogged the rocket vent to do so undetected last night.

"Any other 'ignore maintenance data' commands active?"

"None."

Someone, presumably someone opposed to resettlement of primitivists, had tried something subtle to delay their mission. Or scare them out of it. If they knew Mary's code, they might have access to other mission information. Are we going to be controlled by this? he asked himself.

Also, even if he could convince headquarters to let them launch, his Planet Monitor's judgment said that it would not be a good idea to go right on schedule. Someone was after them. Best take the initiative.

"Tell Mary to start the final prep, with a hold at three eights. We're going to take off as soon as we physically can. Also, don't let this change off ship. Send data that simulates business as usual."

Drin sank to the pad on the bottom of the tank. He slipped his interface headband on over his ears and eyes in a quick motion. Vision fields cleared and it was as if all the ship structure around him had vanished and he was lying on a platform at the bottom of a bubble in the sea.

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That was a little too unnerving, so he adjusted the sonic contrast up a notch until the *Egg*'s ribs and upper cabin became detectable as a sort of transparent gray ghost. A simulated control panel floated in front of him, and he imagined a simulated tongue flicking out to touch the various ethereal controls. This human innovation bothered some Do'utians, but Drin had always liked it—with this, in an emergency, he could react almost as fast as a human.

"Clear here," he announced.

There was a whine of pumps and then a roaring sound that reminded him of being directly under where Go Stohn Falls plunged a dozen charter units into the ocean. The ship stopped rocking as it lifted up on a bed of steam and the thrust feedback system damped out all motion. Then the pressure went up like he'd just dived twenty charter units instead of two. Full acceleration.

"OK, Mary?" he sent.

"Yes . . . I'm . . . fine," she answered, though obviously sounding like she was in discomfort. Well, it wouldn't last. Windstream noise peaked, then began to fall as they left the atmosphere.

The engines gulped water. His effective depth rose rapidly as the water level in the tank around him fell. His hearts increased their beat and his tail tip flicked nervously. This was not a stately elevator ride.

A call came in; "*Trimus Egg*, L2 traffic control. Are you safe?" A Kleth voice, not a computer. Of course! It was Do Tor.

"Do Tor, Lieutenant Drin, greetings. Can we dock early? Or should we modify our trajectory?"

"No traffic, clear to dock. We were supposed to warn you to hold launch because Do'utian protest group in the area. Moot now. How you knew?"

"We had an external anomaly and we decided we'd be safer up here. The question is how did they know?"

"Drin," Mary's voice joined them from her station in the conical cabin of the spacecraft, "that may be my fault. I had a human partner on the negotiation team, really opposed to resettlement. We shared quarters so he knew my key. I'm sorry, I feel rotten about it. My stupid mating instincts."

Another Monitor opposed to resettlement Drin thought. But where did that lead? Connections here, connections there. To what?

"Instincts not stupid by definition," Do Tor offered. "And instinctual behavior not human-only. Elsewhere Ko Kor would have waited to tell us what happened before completion of fate."

Completion of fate, Drin thought: another Do'utian philosophical concept which had percolated throughout Trimus culture. The Kleth could not conceive of continuing life after the death of a mate, but could contemplate prolonging death for a sufficient purpose. They told the tale of an ancient Zan Zor who avenged her mate's murder by feeding herself slowly enough to her children that she was able to name the killer to visitors four days later.

The water surface dropped past him and down into the grate below; what little they needed from now on

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was in bladder tanks that would work in zero acceleration. If things went according to plan, he was done with swimming until they reached Aurum III.

The inner system of the K2 star, Aurum, is dominated by the "brown dwarf" Ember. Trimus, of course, is a satellite of Ember. Two small terrestrial worlds, perhaps tidally ejected outer satellites of Ember, share Ember's orbit.

Aurum II is a small world at the L4 resonance point with a strong magnetic field and a resulting hot exosphere that precludes a dense atmosphere.

Aurum's third planet, at the L5 resonance point, is about half the mass of Trimus, but denser and smaller and so has similar surface gravity (0.76 Do'utia, 0.37 Earth, 0.60 Kleth). It rotates slowly, once every five Trimus days (15 Do'utia, 7 Earth, 10 Kleth) and so has almost no magnetosphere. Prior to bioforming, it had a very thick carbon dioxide atmosphere and a surface temperature near the boiling point of its sterile oceans despite being warmed only by Aurum. Since bioforming, the average surface temperature has stabilized at just over the freezing point of water and the atmospheric pressure at 1.32 Standard Trimus Pressure (2.4 Do'utia, 1.7 Earth, 0.74 Kleth).

—Aurum III Settlement Guide (Draft), Introduction

On approach Drin viewed the orbiting ring of equipment that had done most of the physical work of bioforming Aurum III. Aurum System was a deliberate backwater among local galactic culture, but for eight-squared Trimusian years Aurum III had been one of the most active industrial nodes of the Galaxy, importing quadrocubes of oxygen and spewing out trimadoms of carbon dioxide ice. They'd built a space power facility as large as that of any major transportation node and the attention that attracted down-current, Drin thought, might eventually end their solitude. But for now, with the bioforming job almost done, the machines were surplus and the power system waited for starships that didn't yet know it existed.

Meanwhile, two Kleth scientists had been killed down there.

Aurum III's relatively low mass and extensive atmosphere made for a reasonably gentle maneuver of about twice Trimusian normal gravity. The *Egg* flew broad end first into the first wisps of haze at six times eight-squared macro-units altitude. Its engine exhaust formed a relatively cool layer between the ship and the atmosphere, pushing the hottest part of the entry plume off of the bottom of the ship.

Gradually, Drin's weight built up as the exhaust of the *Egg*'s engines was pushed back into a pad of gas in front of them. The ship tipped its nose down ever so slightly giving it just enough negative lift to counteract the centrifugal effect of their passage around the small planet.

He got heavier and heavier, until he was definitely uncomfortable.

This, he thought, was what a trip to

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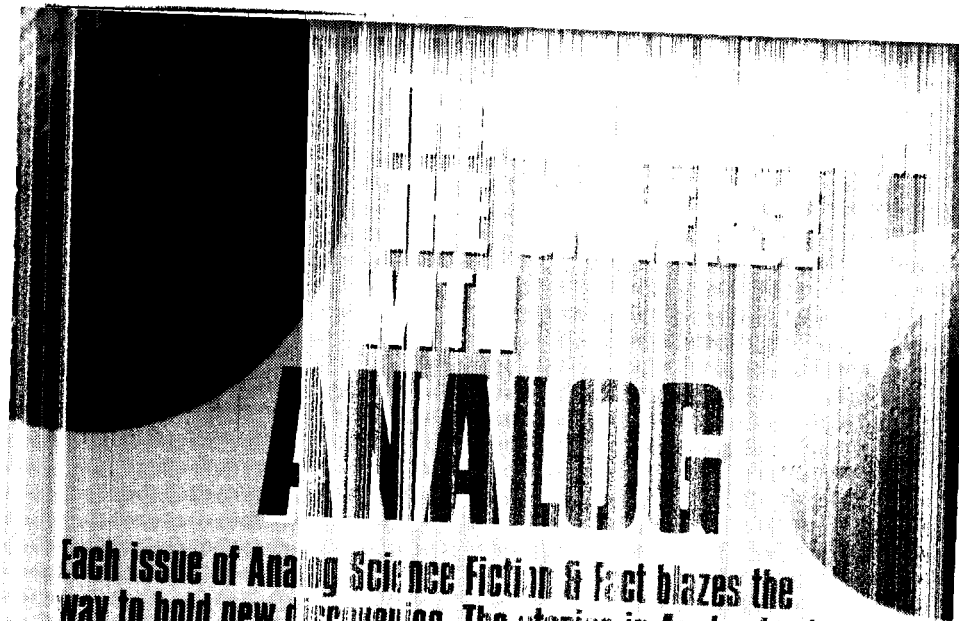

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Mary's Earth would be like. No, thank you. To think that her people had evolved in such a field!

Just when he thought that this was approaching his limit of uncomplaining endurance, it started to let up. He watched the horizon tilt back toward the base of the *Egg* and felt his weight return to almost normal. Terminal velocity. He looked down through the hull and the engines, rendered insubstantial to his viewscreen-covered eyes, and saw the breakers surrounding the target island. Then he made out the charred ruins of the bioforming station.

That hint of scale was all it took. Involuntarily, he groaned. This was exactly like the simulation and it wasn't at all like the simulation. He knew he really *was* falling from a fatal height. Stare *up*, stare up, he told himself. A roar of rockets and a shock of heaviness and pressure hit him. The ship groaned and creaked as it tilted and the rockets roared in compensation.

His beak opened and an involuntary death-wail emerged from his gaping mouth.

Then, almost suddenly, they were quietly floating in an alien sea. Drin spouted in relief as pumps began flooding the tank with minimally filtered external water, for ballast and in case they would have to leave quickly. He sampled the new seawater, and although it was filtered, he got a whiff of a strange smell-set and began, almost unconsciously, to try to deconstruct it. He quickly noticed the lack of the human pollution that had diffused to every corner of Trimus's oceans, but there were other differences.

Drin knew that some minor changes had been made to the species mix that had so far proved successful on Trimus; for instance, Aurum III had no really hot climate zone and lacked warm-water sea life. Nor, due to the dense atmosphere and high axial tilt, was there much glaciation outside of the highest polar mountain ranges. So there was little of anything fetid and less of the ice-melt taste. But what was *that?*

"Lieutenant Drinnil'ib OK?" Go Ton wanted to know, presumably responding to his earlier death-wail.

"Just a traditional new-planet-challenge," Drin covered. Well, he'd used it on every new planet *he'd* landed on. "Everything's fine except there's something funny in the water." What *was* it? "Be right up." Drin slipped off the headband and swam to the top of the rising surface. The three others were at the rail, ready in their field gear—Mary in a sleek gray and white amphibious "second skin" coverall, Go Ton in a loose bright coverall matching her plumage, while Do Tor was in a less conspicuous sky blue.

"Something dangerous?" Mary asked.

"I don't know. I can't identify it."

"Maybe when you get out, it will get clearer."

"Much as I want to get out of this can, we're going to have to be very careful from here on out—help is a long way away. I suggest you take the aircraft ashore with Go Ton and Do Tor and make a first pass at the station ruin. I'll hold the ship in readiness in

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case we have to leave quickly."

"Sure." She reached toward him and he flipped his tongue toward her and held her hand momentarily. Then she looked right at him, and did something she had never done before; she briefly stroked the upper surface of his second finger, almost as intimate a gesture as could be made from her species to his. Then, without saying anything, she let go, waved, and bounded up the catwalk to the upper part of the *Egg*.

Drin drew his branches back into his beak and in the privacy of his mouth, touched the Mary-anointed finger with the head of his other branch. Had she been a Do'utian woman, the gesture would have been an invitation to quicken her ovaries, risk her life, and merge their heritages.

She must know. Did he dare discuss it with her? What did this mean when they were so different biologically? She was three centuries old now; not much younger than he, and perhaps, having experienced everything within the normal bounds of behavior was curious about what might lie just over the line.

As he was.

But what shame he would feel if one like Councilor Gori'allolub ever found out that he had considered exchanging such sensual intimacies with a human. He shuddered; his tail would grow no longer at that! No, no, *no*.

The mathematical model of convergent evolution has itself evolved independently among most of the spacefaring races. Despite wide variation in biological form, the common laws of physics determine which tool-creating behaviors won't work and thus constrain the set of reasoning and future-imaging abilities *that produce technology. So too did the consequences of competitive struggle induce certain necessary similarities, which quantitative sociologists like to call evolutionary attractors, in the games logic of resource territoriality, group cooperation, and bargaining behavior. This theory of fundamental common behavioral motivation underlay the Trimus experiment in multispecies planetary culture.*

—Go Zom's notes on the Compact and Charter of Trimus

"Here's what we found," Mary told him. She sat straddling his neck, leaning forward with her chin resting on the top of his head. "The station ruins were already being overgrown with ivy, but there clearly was an explosion. Go Ton found the detonator right next to the blackened remains of Ko Kor's body. Play the recording."

The *Egg* sounded a tone and the screens at the top of his tank shifted their image from the sea to the outside to the ruined bioforming station. The ivy had overgrown parts of it, but otherwise it looked just as it had at the end of the earlier video record. Their view, recorded from Go Ton's camera, zoomed into the dome through the gaping holes in its top, and after scanning burned benches, empty cages with their doors swinging open and ruined gestation vats, it

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steadied on the carbonized remains of a Kleth, and a small blackened box. Go Ton's hushed voice narrated.

"Memory of Zan Zor, she let flames consume her while she searched for this. She *did* try to tell us, and the idiot rescue party missed it!"

"Oh, yes." Do Tor added in an unaccustomed here and now second voice. "Possible bomb blew off a piece of dome that took head off."

Drin couldn't confirm that from the record; however, he couldn't dismiss it. A freak shrapnel accident? A fragment of dome panel, viewed edge on, would be below the threshold of the recording's resolution. The orientation, however, would have had to be just wrong. And, even if invisible to one sensor, it should have been visible to others. Maybe if the piece was small enough? Drin reviewed Go Ton's recording again, in slow motion. The scorched, partly legible labels of the cages caught his eye; Canis——pus? ——rsus midden——? A piece of the dome roof lay in the burnt wreckage *inside* the dome.

"Aircraft ready," Do Tor's voice announced.

Things were stable here so it was time to go see for himself.

"Coming," Mary answered. "See you outside, Drin."

He finished packing his pouch kit, released the ship to itself, and dove for the tank door.

Once out of the ship, the newness of the Aurum III seas assaulted his senses. The smells of species were clear and distinct, like the notes of a major chord compared to the white noise of Trimus's oceans. It reminded him that ecological control needed to be reestablished here before a random pattern of adaptive radiation took hold—one in which the planned human and Do'utian components might not fit so well.

It also puzzled him that there were still a couple of notes in this simple olfactory harmony that he could not identify. Then he recognized one of them as not dissimilar to the Earth sawfish he had enjoyed so often on Trimus. Of course, he thought. Its diet would be slightly different here and its excretion likewise.

He had a lot to learn, and looked forward to it.

Free of the spacecraft propellant tank, Drin stretched his muscles and shot through the water with enormous, powerful tail strokes, closing his eyes to shield them from the pressure of his passage. In front, his bony nose cleaved a sea that felt almost as dense as flesh from the violence of his speed.

Out of breath, he shot for the surface, and with a mighty and well-timed tail crack shot out of the surface, reaching a full two charter units above the watertops. Oh, the exhiliaration of it! Oh, the freedom.

He expelled his old air in a mighty bass note, and felt the reaction push him back like a steam rocket.

"Gesundheit!" Mary radioed from the aircraft, a double teardrop in a rounded delta wing hovering on its wing fans only a few meters higher than he had leapt.

He twisted in midair to take the impact on his back and protect his legs. The tremendous splash scraped

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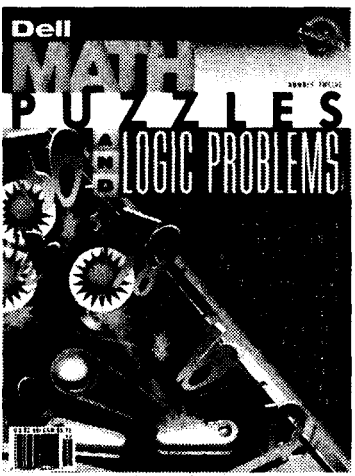

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his back clean and no doubt stunned a lunch's worth of fish.

"More care, Lieutenant. Aircraft not submarine capable," a worried Do Tor honked.

"Oh, no," his mate added.

"Wow! How old did you say you were?" Mary laughed. Then stopped abruptly. "Drin! The ship!"

He bent to the right and looked back.

A great hole had suddenly appeared in the rounded upper dome of the tank, just below the conical cabin, only a doci or two above the waterline. Then as he watched there was a flash of steam and another one appeared next to it. The conical cabin, deprived of support, began to sag into it.

The aircraft accelerated, banked, and started to turn back toward the ship.

"No!" Drin roared. "Do Tor, ditch! Now! Take the aircraft into the sea!"

"Say WHAT!?" Do Tor protested.

"Dive!" Drin shouted. "Get that egg-polluting thing under water!"

For no reason that Drin could see, a part of the aircraft's wing fell off before it knifed down into the waves.

A cone of air over the dying spacecraft, blasted into luminescence by gamma radiation, was now much brighter than distant, cloud-filtered Aurum. Just as he dove after the aircraft, he felt an enormous sting near the base of his tail. A piece of the ship? Or had something bitten him? But what?

No time for that now. He doubled back on himself and slammed water behind him sprinting toward the sinking aircraft.

The bubble canopy was filling rapidly with water, but his comrades seemed all conscious, with their heads above the water level. The impact had torn away the wings, but for that the aircraft seemed intact. He dove alongside, matched sinking rates, twisted, and grabbed the machine between his front legs. Then, cradling it much as an Earth-otter might cradle a shellfish or a young otter, he rose back to a depth of about half a charter unit. The bubble in the canopy expanded and Mary nodded at him as if to say, "we're OK."

The sky above the ocean was insanely bright and filtered down as a hellish blue-white. There should be, he thought, no reason anyone should suspect that they survived that blast. For avoiding another attack, that might give them some breathing room, but for rescue, it could be a problem.

Sentient omnivores were designed into the Trimus ecological system from the beginning, and size limits were engineered into its subsentient carnivores. There were no big cats or U'ulatan spear-tooth packs on land, no great white sharks in the oceans, no deathspores in its skies; nothing large, numerous or vicious enough to threaten unarmed members of the three sentient species in their own element. The birthrates of some large herbivores were lowered as well, and a certain amount of culling by traditional hunting methods was a design expectation.

—Planet Monitor's Handbook,
Ecological Appendix

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* * *

Mary could pack twice her mass for long treks without complaining. Do Tor could *fly* with a burden almost as massive as he was. Drin's folk, however, did very well to manage their own bulk on land and even his finely honed, athletic Planet Monitor's body would have been quickly worn down by a burden only one-fourth his own mass. And after eight squared days in near-zero gravity, about the best he could manage comfortably for long periods was about one-eighth more than he weighed.

Therefore, because that eighth was easily eight times more than Mary, Do Tor, and Go Ton combined could carry, Drin carried *everything,* including Mary. Absolute size matters.

Besides, there wasn't that much left to carry. A medical kit salvaged from the aircraft. The core of its cybersystem and its communications equipment. Emergency tents and blankets. Dart gun ammunition. Containers for boiling liquids. A rotary generator. An analyzer.

All the electronics were powered off. The first thing that had occurred to all of them was that electronic noise was one common denominator with respect to whatever had attacked the bio-station, the spacecraft, and the aircraft. Another common denominator was location, and they were making a reasonable effort at changing that before powering anything.

Do Tor suggested a cave. Drin had replied that that made sense, but it had better be a big one. So Do Tor and Go Ton were off looking along the banks of a deep river on the other side of the island.

The forest was cool and moist; the trees wetted him as he pushed through them, following a small creek. Aurum was haze dimmed and the chill polar wind kept him comfortably cool. He would need to eat well in a dozen days or so, but for now the enforced abstinence was good for him. The smells were the smells of wild wood; Earth pine with its sharp needles, broad olli'ulstican leaves, light and bright with a fruity bouquet, stolid aspen. The animal community came with a breeze from some nearby trail; nimble six-legged squirrels from Kleth, a whiff of Earth dog, running free. The ripe droppings of the carrion-gull from his grandparent world. The smells were familiar, but in a new, free, clean environment.

In fact, given their situation, he was feeling unreasonably good except for his back.

"Mary, could I ask you something very personal?"

"Sure."

"My back still itches where something bit me after the ship blew. Would you scratch the scar?"

"OK." She yawned. Then he felt her skitter down his rolling back past the equipment pallet to the base of his tail. She went immediately to the right place, which surprised him. It should be well healed by now.

"Drin," her voice was much sharper now. "I don't want to scare you, but there's something still in there, and it's pretty deep."

"Oh?" he rumbled and stopped, then bent his head back in a painful

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contortion to look. There was indeed a deep long gash in his blubber, still oozing. Pollution! He should do something about that. It was time for a rest anyway, Aurum had come out from its cloudy veil, the wind had slacked, and he needed to stop generating body heat and let his temperature back off for a bit.

"I think we have the med kit. Do you want to try to dig it out now? I could use a rest, and I won't feel much unless it gets below the fatty layer. What is it?"

"It looks like a silvery wire. Maybe some kind of monofilament."

"Pollution!" Drin lowered himself to his belly and held himself motionless. Every movement he'd made for the last hour had probably worked the thing in deeper. "Talk about vicious sabotage! No wonder Soames didn't surrender. . . . Look, the forceps in the kit are solid diamond, they should be able to handle it, even if it is monofilament. And Mary, remember that what looks like a horrendous wound to you may be a minor nick to me. So even if whatever it is cuts in deeper, please keep your fingers away from it!"

"Roger that." After lots of "umms," "ahs," and "uh huhs," she declared victory. "OK, I have it. Long, thin, silvery thing." She held up the forceps. Drin could see nothing.

"You'll have to bring it closer for me."

"I'll put it in a sample jar and tape you up, first."

Drin grumbled as she squeezed fluids from tubes, tugged here and there. Then Mary was in front of his left eye with a shallow clear diamond sample jar. He sent a branch of his tongue out to take it.

The lens of Drin's eye was almost as wide as the jar, and evolution in and out of the water had given him the focusing ability and retina to take full advantage of that aperture. With the fingers on the other branch, he removed the lid, stuck the forceps in, and moved the filament around.

It didn't seem to be a single strand, but something rather more complex. And, just on the limit of his vision, there appeared to be nodules or grains of some kind. He managed to isolate one, lift it up, and shake it. For a moment, it caught the light just right, and it looked like a net of some kind.

"A spider web?" Mary asked, her voice soft with wonder. "What kind of spider? What kind of web?"

"Possibly monofilament," Drin guessed, "a fullerene, or a string of some kind of nanites. We'd need more equipment to find out, but I suspect from the video of the attack that, all spread out, the thing is a circle about a quarter charter unit in diameter. If it lands on something, the nodes work their way through it, pulling the filament along between them."

"Organic, or mechanical?"

"Or organomechanic. No polluting way to tell just now." Drin put the lid back on the sample jar. "I'd guess from what we've seen that it makes short work of hard composites and metals, but gets bogged down after a few eight-docis in soft wet stuff. Like me."

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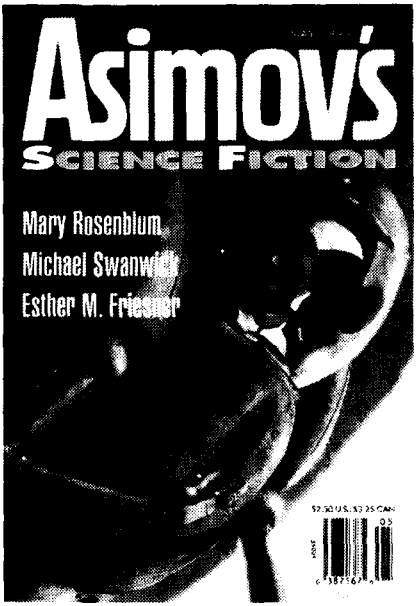

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"Or sea water?"

"That's what you and I are, mostly. Seawater and pollution. Well, we have a clue."

"But," Mary asked, "is this something a fanatic saboteur could concoct at a bioforming base? Why both the bomb *and* the spiderwebs? Or did they come from somewhere else?"

They spent the rest of the journey to their new cave home in deep thought.

For environmental reasons, Kleth power transmission technology had spread throughout the Local Worlds long before the founding of Trimus. Superconducting waveguide tubing for far infrared produces no external fields, can be strung long distances under ground or water, and carries information as well as power. A sudden line break may produce a transient high intensity beam, but standard connectors shut down the minimagnetron arrays instantly when a break is detected.

—Planet Monitor's Handbook,
Technical Appendix

The cave was too small, Drin complained to himself, as he scraped his back returning from a futile trip to the ruined station some days later. He couldn't turn around in the partly submerged lava tube except just inside the weathered out, half-submerged mouth, where the black sand floor rose almost to the widest part of the tube. The gentle solar tides of Aurum III rose only a doci or so, but on the nearly level sand of the tube, it made almost a charter unit of difference in where the estuary shoreline fell, cutting the floor area in half at high tide, making the place feel even more claustrophobic.

Someday he would excavate a more comfortable channel and create a larger dry area, but today his mind was on a different technical problem. They had equipment, they had a source of power, but somehow during the explosion at the station, the rotary generator's output lead had been damaged, leaving bare wave guide and no way to get the power out. Without power, they had no way to call for help or warn anyone about the nets until someone came in range of their personal communicators. And once their batteries gave out, they would be, effectively, stuck in the shell age.

"Mary?" Drin called, softly lest the echoes in the confined space deafen him.

An awful buzzing racket ensued, then a cloud of dust and debris fell from the roof and rolled toward him. He backed up, getting his tail in the water again. He felt, then heard, a solid thump and saw a largish rock roll out of the settling cloud of dust. Then there was a smaller thump.

"Hi, Drin." It was Mary, grinning, clothed in volcanic rock dust, wielding a vibrosaw they had salvaged from the biostation ruins. "In one fell swoop, ahem, I've made a back door for me, a front door for the Kleth, and a chimney. A few more days of work, and this place will be habitable."

"I am glad we have *some* good news. I couldn't find any usable con-

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nectors in the ruins."

Mary's teeth disappeared. "Nuts."

"I think," he offered, "the next step is to check the wreckage of the *Egg*."

"I guess. Drin, I keep thinking I should be able to do something with what we have."

Drin looked away in negation. "I can't see how. Wave guide power transceivers need infrared wave scale dimitech, or maybe minilithography, and the best we have in our tool kit is a miniwaldo set. I hate to think of how long—"

"OK, OK, let's go on an *Egg* hunt." She ran to the water, splashed in up to her knees, made a shallow dive, and surfaced halfway to the cave mouth, then started pulling herself back to the shore, laughing. "Actually, I should get a couple things together first. Can you wait a bit?"

"Mary, I think there's going to be more residual radiation than you should see. Especially if we get stuck here for years. You should stay."

She slumped. "You're right as usual, Lieutenant. Look, Drin?" She shook water off of her head, hair flying.

"Yes?"

She pressed herself warmly against the side of his head and murmured. "Come back, huh?"

Drin touched the tip of his beak to the sand beside her. Two could play the game of inappropriate courtship signals, he thought. She laughed and kissed the top of his head.

Then he backed out into the wider part of the cave, turned and swam out into the river.

Once in the stream he sounded briefly, then sent a blast of steam into the air. Do Tor and Go Ton soon appeared overhead, and he told them what he intended and asked for some air cover.

Aurum III is a world of exaggerated vertical scale, above and below water. Its volcanoes reach over four macro-units above sea level and not much less than that below to the main ocean floor. The main mode of crust cycling, as with many smaller hot-core worlds, is sublithic thermal deconstruction: new eruptions covering older shield deposits, weighing them down, hydrostatic readjustment taking ancient layers down below the mantle, where they decompose, releasing their gasses. Thus many volcanic plateaus are surrounded by deep trenches and hot springs.

—Aurum III Settlement Guide (Draft), Geology Supplement

The marginal trench was a dive beyond even Drin, but the *Egg* had touched down just landward of the edge of the island shield, and he hoped to find at least some debris there.

Again, what was that smell? An Earth species, certainly, but not one he could place.

He broached and scanned the air. Do Tor and Go Ton were circling overhead like a pair of Do'utian diving gulls looking for floating carrion—the black humor of that analogy made him chortle. He would have said something, but they were conserving communicator power —no one knew when they would get

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to charge them again.

A few beats later, Drin's sense of location told him that he was over the wreck, and he sent a single spout skyward, a prearranged signal to let them know everything was fine. Then he dove down, and down. The water was cold and stagnant, and illumination was only a matter of some shadows being less dark than others. He started chirping, and a fuzzy sonar scene formed below. Lava pillows, large spiral-shelled shellfish from Kleth, occasional small fuzzies, and—there, he found it, about eight-squared charter units down and left: the half shell wreck of the *Trimus Egg*.

It astounded him that so much had survived, but gammas and pions traveled too far in mere air to make for a concentrated explosion, and near-field heating may have slowed the mixing rate. Still, as he drew near, he could smell the carbon and metal ash of materials heated to their kindling temperature.

He was silent, and as the sonic images faded from his perception, a faint blue glow remained.

So, the remaining structure must still be radioactive, almost five days after its exposure. He sent a tongue branch into his pouch for a radiometer.

And backed water immediately when it started glowing red-orange.

A fear began to develop in him, a suspicion. Nervously, he ascended a bit and swam directly over the hulk. The radiometer was non-directional, but he could use his body to occult the source; in effect locating it by seeing which way his body's radiation shadow pointed. In his shadow, the detector dimmed to a dull red, then as he got out of the way, went back up to orange.

Several trials, turning in different directions, showed him that, as near as he could tell, it was a point source. There was only one possible explanation; at least one of the antihydrogen dewars had survived and must be leaking, still trying to feed antihydrogen to a converter. How?

He descended to bottom and sunk to his belly in the detritus ooze. The radiometer went almost down to black, and he released a bubble of relief. He had time to think.

Of course, the converters! Their walls were tungsten an eighth of a doci thick, and they surrounded each dewar in a cluster. It was a safety feature designed so that in case one of the clusters was breached, the resulting radiation would not damage the others.

He'd known the things were diamond-tough, but this was unexpected. Not only had the engineering actually worked, it had worked too well! It would have been much better if everything had let go when the ship was hit.

With the cold deep water as a heat sink, the solid state electron heat pumps would have much less work to do, and the dewar's emergency power supply might last this long. But when it gave out, the antihydrogen ice in the core would start to evaporate, react within the inner chamber walls, and evaporate more antihydrogen in a runaway reaction that would

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cause the dewar walls to fail from radiation damage. Then the dewar would collapse instantly under the water pressure, causing all the remaining antihydrogen to be mixed with matter. Not in a fizzle of several minibeats, but, essentially, at once.

That could happen, he realized, at any time, or be set off by any shock wave, or perhaps a disturbance. But they still needed the power converter. And, since the remaining dewars would eventually fail anyway, it would probably be better to set them all off deliberately, at a known time.

Their supplies had included some command-fused explosives, he recalled, stored in one of the cargo lockers at the unfueled waterline. Before he could talk himself out of it, he took a hand lamp from his pouch, crept up to the hulk and began to circle it, looking for the locker. Crazily, despite the fact that the upper two-thirds of the spacecraft had been vaporized, enough of the bottom of the tank had survived in places to allow one to imagine that nothing had happened!

He found the locker about a third of the way around the hulk. Very gingerly, he worked the manual release, and was rewarded by an intact storage hold—a virtual treasure trove, considering their circumstances. There were the explosives lockers, vibro drills, floodlights, diamond coated fiber line, an inflatable cargo raft, and a Do'utian beak shovel.

He permitted himself a slight purr of satisfaction. The shovel was a simple tool that would let him dig and move many times the amount of mass he could move with his tongue. The invention of such tools had played a role in Do'utian civilization comparable to that of the horse harness for humans. The DCF line was thin, light, high-tensile strength, and just about indestructible. Best of all, the floodlights, of course, had two each standard power connector splices!

Carefully, he unloaded the raft and set the rest of his treasure in it. He vented an explosive locker and withdrew four charges and put them in his pouch. Using the DCF line, he tied the beak shovel in three places so it would hang below the raft and tend to keep it upright. Then he inflated the raft and sent it toward the surface loaded with his treasure.

Drin went around the exposed underside of the hull with his radiation meter, hoping that he could find the leaking dewar and place the charges on the hull just opposite it. But after several minutes he realized he would have no such luck, and would have to go into the wreck.

He put the radiation meter in his pouch—he would have to do this as fast as Do'utianly possible, and looking at the meter would only waste time. With the charges in one hand and the light in another he went up over the torn rim of the hull. Where?

He flicked off the light and in a couple of beats, saw a faint cone of blue. Don't hesitate, he told himself, and swam directly to it. The floor grid was still perversely intact. Did he dare risk raising a panel? He wasted time in a frustrated near panic about that before it occurred to him to see if the charges would fit through the holes

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in the gridwork

They did, just barely. He activated them in sonic command mode, getting a confirmatory blink on the end of each. Then he forced them through the gridwork, letting them fall below to the bulkhead just over the converters and dewars, each hitting with a nerve-rattling clank.

As soon as the last one fell through, he pushed himself up, swam *gently* back over the rim and away from the wreck until he was several charter units clear, then abandoning himself to justifiable terror, he sped for the surface.

A charter unit from broaching, Drin bent his course parallel to the surface and located the beak shovel hanging from the raft, then raced for it, surfaced, and looked toward the sky for the Kleth.

"Drin? Drin!"

He rolled his eyes to the cargo raft itself. Do Tor and Go Ton were calmly seated on the left pontoon, wings folded, their horny feet brushing the wavetops.

"Good hunting!" Do Tor congratulated him.

"Oh, yes." Go Ton added.

"Monitors, we need to leave quickly. Some of the antihydrogen dewars survived the nets—"

The Kleth wings popped out in unison.

"—And may implode at any time." Drin dove under the raft, grabbed the beak shovel, surfaced and put it in the raft. As he opened his beak, he got a strong taste of the strange sea life he'd smelled earlier. No time to investigate now, he thought. He considered dragging the raft for a moment, then changed his mind, dove under and surfaced beneath it, so that it draped over his broad back.

The Kleth had taken to the air, and were circling Drin as he made the best surface speed toward the island.

"Is your friend coming too?" Do Tor asked.

Drin swiveled an eye back along the surface and saw a large, white, erect fin knifing along beside him, about three charter units to his left. Underwater it looked to be an Earth fish with a conical head that was unusually wide across. It had several gill slits, instead of the usual one. Also, the mouth wasn't in the usual place. There, Drin thought, that slit below the head must be it.

An alien?

If so, it was a large one, almost half as long as he was. And why the Earth smell?

It decided to move in to investigate him. It closed rapidly. It opened its mouth.

Drin's afterbrain took over. His foreleg, muscled for carrying half his weight around on land was already in motion when the great grayish-white fish opened its mouth. The thing, which seemed originally intent on striking at Drin's nonexistent gills, started to change its target.

Drin's claw, without any conscious control from him, missed the head, but still caught the thing just behind the gills, and the next thing he knew, he had the front third of it painfully clamped onto his leg while the rest floated away, spewing fluids into the sea.

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After seeing a demonstration, Mary, Drin remembered, had likened a blow from Drin's foreleg to striking something with a huge serrated axe.

"Mary calls them sharks," Do Tor called.

Them?

A quick look found three more and a ping illuminated four. One of them headed for the rear half of their companion, and two headed for him. Drin sounded, heading straight down as fast as he could, shaking off the head of the first shark from his foreleg about halfway down. That got the other shark's attention long enough for him to get well away.

The wound in his leg was deep and painful. How, he wondered, had a mouth in that clumsy position been able to do *that?* His leg bled.

Out of nowhere, another shark appeared and started diving after him. Drin sent his tongue into his pouch and pulled out his gun. Then he jackknifed and faced the thing, waited until it was almost on him, and put an explosive bullet into it.

He had to weigh ten times what the sharks did, and individually, they were no match for him. But he knew that, collectively, they would easily wear him down before he could reach the safety of land. Was there any way Do Tor and Go Ton could help him?

His afterbrain, responding to minute water pressure variations, slammed his tail into another of the creatures before he realized what was happening. It floated stunned in the water.

Bait.

He quickly jackknifed back, nipped the shark in two, stuffed the back half down his throat for a long overdue meal, and held the polluting front part distastefully sealed inside his mouth. Then he headed for the surface as fast as he could, counting on the sheer speed of his ascent to protect him.

It did. He shot out of the water to an altitude of about a charter unit, and almost hit circling Do Tor.

"Cover me with your guns!" Drin boomed. Then he twisted on his back and struck the water with a stinging maximum impact. Two or three sharks floated senseless on the surface. Drin snapped them up and headed directly over the wreckage of the spacecraft, nipping heads off as he went.

"I count three eights of sharks," Do Tor called. A shot rang out. Two eights and seven, now, Drin hoped.

"Three eights six," Do Tor corrected his optimism, as if reading his mind. Several more shots rang out and even more sharks appeared.

"Fine!" Drin roared in frustration. "I'll take every one of the polluting things in the whole polluting ocean with me."

He arrived over the wreck, filled his lungs as best he could on the fly, and headed *down,* expelling the gory mess in his mouth to distract any followers. It seemed to work; they congregated over the wreck for the leavings and he couldn't detect any of the beasts on his tail, but he didn't slow down to check more carefully. About ten charter units down, he bent his course back to the raft, broached in

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a long low arc, barely clearing the waves, and turned his comset on. It was time to use the batteries.

"Monitors, Lieutenant Drin. I'm going to detonate the rest of the ship, soon. Get set for a big wave. Tell Mary."

He reached the raft and saw no sign of sharks. He grabbed the emergency light with one branch of his tongue, the coil of DCF line with the other, and pulled them back into his mouth. Afraid to try to save anything more, he headed away from the site as fast as he still could. Exhaustion, and what was probably the onset of radiation sickness, were slowing him considerably. He was having to spout much more frequently than usual. Fluid in his lungs. And he was pissing torrents.

Do Tor and Go Ton were pacing him overhead.

"Do Tor, Go Ton," he sent, "best help Mary prepare. The wave will likely put the cave under."

"Monitors, Mary, I think I'm set for anything. Suggest you stay with Drinnil'ib."

"No, Mary. The air won't be safe here. They'd best go. I'm not fragile, and I intend to get through this." He didn't mention the sickness. "Do Tor, get out of here. Orders. I'm going to detonate it now."

Without waiting for an argument, he sounded. He thought furiously; he had to be in the water to send the sonic command but he wanted to be out of the water when the shock arrived. He might have one good broach left in him, he thought, and he would have to time it just right. He tried to calculate, but it was too complicated, distances too uncertain, and he was too tired. So he guessed and sent the command when he was full speed *up*, halfway back to the surface.

With one last, desperate, slam of his tail he vaulted above the wave tops. He seemed to hang in the air forever while nothing happened, then, just before his back touched the water again, three ripples went by under him, extremely fast, deceptively small. He'd saved his hearing, he thought as he plunged in, by less than a fraction of a beat.

Drin surfaced again, looked back, and almost wished he hadn't. A huge dome of sea had grown behind him with incredible speed, and the nearer part was transforming itself into a wall of onrushing water almost eight-squared charter units high.

Drin spouted once more and filled his lungs as best he could and rose with the wave.

It was like being in the spaceship at launch again. He was lifted up and up as he tried to swim down. He couldn't stay under, and his head came out of the water on the slope of a huge hill of liquid. The wind howled like the worst part of a Coriolis storm. He could see Do Tor and Go Ton in the distance racing away, and his sense of level told him he was looking *down* on them.

A glance at the island confirmed that. The wave, he estimated, would inundate all but the highest peaks.

Then he was sliding down the hill of water at incredible speed toward the island. He pushed his legs forward to slow himself, spreading the webs between his claws.

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And found himself standing on an almost glass-smooth wave, toes out of water. He didn't dare fall. He couldn't make himself breathe.

With his eyes on the side of his head, he had nearly seven-eighths of a sphere of vision, and processing this, the physiologists said, was what most of his massive forebrain did. It was usually a blessing, but just now it enabled him to see the top of the wave, far above him, start to curl forward and break into white foam. Behind and above that a column of dirty steam rose up to the cloud deck like a cosmic-scale ring-shelf plant, and likely far beyond.

Drin's wave was headed toward a steep volcanic cone on the end of a peninsula stretching out from the island. Instinctively, he tried to lean away from it, and his path actually bent slightly. The feeling of having even that little bit of control over what was happening to him unfroze his mind. He was headed too far inland to skate around the outside of the cone, but the saddle land connecting it with the rest of the island was low. He bent that way.

It was actually a short cut, he thought with some grim humor. The mouth of the river of their cave was on the other side of the gap, just toward the main part of the island.

The water ahead of him rose up between the main island and the cone—the wave was being funneled between the two. Its speed slackened and Drin settled from his feet back onto his belly, still sliding down an advancing slope of water, still in control.

He shot through the gap in an instant, then cubes and cubes of water crashed down on him, twisting him this way and that as his weakened and abused muscles strained and strained, trying to hold himself together. Finally it abated, and he let himself roll with it.

Eight cubed charter units from the island, what remained of the wave had passed by under him, and he found himself floating in what seemed to be a more or less normal sea.

He tried a gentle tail stroke to send him landward, but it hurt too much.

His legs seemed to have fared better than his back, however, and he was able to begin paddling, Mary-fashion, back toward the cave, letting his tortured back muscles rest.

Even this far out, he could see the devastation; only one tree in ten still standing, those leaning, the beaches covered with debris, the river choked with fallen trees and reduced to a trickle.

From this side of the peninsula, he could see that a huge bite had been washed from the base of the volcanic cone leaving a hard lava core to jut out at an impossible angle toward a side vent that was no longer there.

His eyes went to the beach again; there seemed to be more of it than a minute before. In fact. . . .

He looked behind him. The water was rising there.

Ignoring his pain, he swung himself around and began swimming with as much speed as he could manage, away from the beach.

He rose higher, and higher, and felt

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the wind build up again. He did not look back a moment, but kept struggling up the wave. Finally he sounded directly into it, then emerged again, unable to stay down. But he felt himself falling; he had passed through the wave before it had formed a crest.

He let himself drift around, totally exhausted, spouting pink with every breath, and watched the incoming wave hammer the island. He floated for subjective ages, fading in and out of coherence. Finally, with a great effort, he reached into his pouch for his gun, and brought it into his mouth.

If the sharks came now, he was done. He estimated the things could chew at him for hours before they got to anything definitely vital. But he wouldn't suffer that. As a last resort, he could still put an explosive bullet in his forebrain and not experience his own undoing.

With such cold security achieved, he recovered some psychological energy, and began to paddle himself toward the river mouth. The sky above was a strange blood red; Aurum was peaking below the cloud deck, lighting it from below creating a strange scene of crimson lit billows and gray shadows. Their sun had almost completed its slow journey to the horizon and would hang there for a day before it started up again in this world's arctic summer. From the shore, an Earth dog howled the way Drin had never heard one howl before, carrying clearly over the waves. The sea, reflecting the sky, seemed to be made of blood.

Drin fought the remaining current with his legs, pulling himself slowly upstream. He keyed his comset. "Mary?"

No answer.

"Do Tor?"

Nothing.

"Test?"

Nothing. The unit was dead; probably from having been left on too long, since no pounding that left his pouch intact could possibly have harmed it.

Of course, there had been the electromagnetic pulse of the explosion.

He put it back in his pouch; he'd assume a power problem for now.

He rested. He moved forward a few more charter units. He rested. He moved. He rested.

Had he come upstream far enough? His sense of position told him he had, but the landscape looked completely unfamiliar; the channel seemed to run too far south.

Where was the cave?

He scanned the north shore, across a field of freshly deposited sand.

There; a rough arch of lava sticking out of the sand. The lava field behind it looked familiar, too. He opened his beak.

"Mary?" he groaned, thinking it probably sounded more like an acoustic fog warning than a name.

"Drin, Drin!" her high pitched voice came echoing back, seeming to be from a million miles away. Then her frosty blond head popped out through the hole she'd cut in the top of the cave.

"Drin!" she screamed, sounding much closer now.

Her hair was matted and dirty. She had angry red marks on her face, and she limped as she ran toward him on

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the sand. A hand was heavily bandaged.

With a last, gigantic effort, he struggled a few steps onto the sand to meet her, and fell on his belly, completely spent.

She threw herself against his head and tried to hold herself there, repeating his name over and over.

He opened his beak slightly and slipped the branches of his tongue around her, holding her to him. They stayed that way until she seemed to regain her composure.

"Drin, we got through it. I broke a finger and wrecked a knee. Do Tor has a hole in his wing, and Go Ton is trying to patch it with one hand and guard our prisoner with the other, so I have to get back and help. Then I'll be back with the med kit for you. And Drin, for whatever crazy kind of sense it makes, I love you. I have to say that, and say it now before anything like that ever happens again without my having said it. I love you."

Drin couldn't think of anything rational to say on that subject, but he was suddenly aware that his mouth was sore from the things that had rattled around inside it.

He let go of Mary and took them out and spread them before her.

"I found some connectors," he said.

She waved an arm at the devastated island around them, started laughing and seemed unable to stop. What was so funny? Drin thought. They *needed* the connectors. Did she say *prisoner?*

In seeking the explanations of things that happen, create many models before discarding any. Understand the difference between a fact and an assumption. Do not project your rationality on what may be the result of an irrational act or non-rational happenstance. Learn the differing motivations of the other sentients.

—Planet Monitor's Handbook,
Forensic Methodology

The prisoner, Drin decided, was one of the most abject and miserable human beings he had ever encountered. Theric Soames was so tight, surly, and touchy that conversation was impossible. Mary didn't want to use drugs, but they had to find out about the nets, and find out soon. So she had asked them all to leave. She wanted to continue the interrogation human to human, without drugs.

"Trust me, please," she told Drin. So he assented to their return to the privacy of the cave.

There was plentiful dead wood all over the island now, and Go Ton had started a large fire. For one of the few times in his life, Drin welcomed the warmth. Do Tor sat on a log near him. He was restive from not flying while his wing healed, and Go Ton was being exceptionally attentive while she was around, which was not always. Go Ton was the only one of them physically fit enough to collect food for them. Incredibly, she managed.

Drin regurgitated a salmon skeleton and cast it away.

"How do you do it?" he asked.

"Made net from the line you brought. Put across river bed near new rapids. Collect fish."

"Your energy is a marvel. I should

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be able to help myself in a few more days." "Day," especially here in eternal light of high arctic summer, still meant a Trimus day to them and not the leisurely rotation of Aurum III. But for some beings in the mists of the future, Drin reflected, that would change.

"You realize," Drin remarked to his Kleth partners, "that there is nothing that validates our Trimusian culture more than to plant a secondary colony. At this point, we stop worrying about whether our ancestors came from Do'utia, Kleth or Earth. We are now all from Trimus!"

"Oh, yes," Go Ton agreed. "But we can never be the same, so always tension between three and one. So Mary insists we stay away while she interrogates Soames. Does human-separate things maybe we should not see, but she does them *for* Trimus."

"Oh." Drin rumbled. Emotionally, his attachment to Mary, despite his best intentions, was approaching that of a bull for a harem cow. This was utterly, totally unreasonable, yet what Mary might be doing to induce Soames to talk tasted like a polluted stream to him. But perhaps his Kleth friends could help him. Go Ton's perspective was interesting and comforting.

"Go Ton, what do you think the English word 'perverse' means?"

"Deviating from what is considered socially acceptable. Definition relative, not absolute."

"How much affection can there be between different species before Trimus culture considers it not socially acceptable?"

Do Tor flapped a bit of wing, indicating to his mate that he wished to take over the conversation. Go Ton emitted a low coo of consent.

"You and Mary?"

Drin hesitated a long time. "Yes," he finally said.

"No shame in that to me. Touch friendship natural for both your species. Not for Kleth."

"Oh, yes," Go Ton added. "But we're progressive Kleth. See how much Do Tor lets me talk?"

Do Tor flapped a bit again, then made the sort of hiccoughing humor sound of his people's laughter. "Trimusian Kleth," he said, "are considered perverse, by traditionalists on Kleth, because of the very name Trimus. On ancient Kleth, one doesn't speak of three. Know you why?"

"No. Of course I am curious, but you do not have to tell me."

"You have told us dangerous secret so we tell you one. Our nests hold three eggs, one from each of three pairs. Two eggs one sex, one the other. Everything fine for seven or eight days. Then nest is too small. While parents away, a choice is made, and two eat the one."

"Huh," Drin rumbled, "You have seen my people's beach manners. We are all part of nature. The fight to live selects the strong."

"No fight," Do Tor corrected him. "Sacrifice. The one who is to die chooses self by not defending. But sometime not."

"Oh, yes." Go Ton added. "On old Kleth, for every six eight-cubed couples, one triple. Great perversion. Parents flee or be killed. Sometimes

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two triples get together and pretend to be three couples. Considered witches, demons if discovered in old days. You and Mary not perverse. Are interesting. Three Kleth is perverse."

"But essential, at the start, by what you say." Drin remarked.

"Big question, hard for Kleth to discuss, hard to study. Nothing recorded, but two-egg nests usually fight, then one wins and both die. No one talks about it. Our third nestmate was intelligent being, like anyone. No biological difference. Do Tor and I start life by killing and eating our nest mate. Instinct, not decision, but we remember. Our genetic engineers can change this, but the result isn't Kleth. You can tell Mary," Do Tor said, "no else, please."

"I don't judge you," Drin said. "You are my friends. I will not speak of it to others."

"Good. So we not tell others what you and Mary do."

Drin's recharged communicator asked for his attention before he could think of a reply.

"Yes, Mary?"

"I'm bringing Soames back. He freely admits that he planted the bomb in the bioforming station, arguing that it was philosophically justifiable to prevent the inundation of Aurum III with transplanted primitivists. He remained resolutely silent with respect to who else on Trimus was party to this effort to sabotage a Council decision.

"But he emphatically denied having anything to do with the nets, and claimed to know nothing about them. He seemed genuinely surprised when he saw their captive sample, and pointed out that it had come as close to killing him as anyone. I suppose you'll want to talk to him."

"I certainly do. And, Mary?"

"Yes?"

"Did your mother have access to your codes?"

"Drin! Karen Olsen is the architect of the resettlement policy! Yes, she's the alternate custodian of my personal files, but there is no way—"

"No offense, little one, I don't think she is a suspect. But we might have to worry about anyone close enough to her to have access to her files, as your roommate did to yours."

"I see. She's not like me, that way. She hasn't been active, that way, that I know of, for some time."

"Very well. Warn her if you trust her. Mary, do you have your gun handy?"

"Yes. Why?"

"Do you remember the burnt labels on the cages in the bioforming station?"

"Uh, Canis something, a type of dog: those little hairy carnivores with the high-pitched yap that we keep as pets. The other one was Kleth I think. If it were Earth life, the genus might have been Ursus, which would have been a bear, and I don't think they would . . . . oh. The howls."

"Someone," Drin rumbled, "has cleverly revised the ecology of this project to make it hostile to settlement. I was trying to think of what might be the equivalent of sharks on land."

While what our Trimusian pio-

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neers did was almost radical, it was done for a very conservative reason. The pioneers of all three species were dedicated to the idea that a stable interspecies culture could be created without significantly reengineering the brains and endocrinological systems of its participants. They did this in full knowledge that most of the galaxy and even their own homeworlds would eventually look on them and their descendants as living fossils, but they were comfortable with that destiny, and so far, we have been able to sustain it, with varying degrees of dedication.

—Go Zom's notes on the Compact of Trimus

"Now," Do Tor shouted from aloft.

Drin released the water wheel by taking his left foreleg off the radial beam, and it started turning. The general purpose line wrapped twice around the rim of the lava stone flywheel on the same *pine* log, went down one side, twice around a groove carved in another smaller stone disk, and back up again. That disk was attached to their generator's input shaft.

He watched the lash-up turn nervously; the flywheel axle rested on four magnetic bearing casters, salvaged from a cart in the ruin of the station, that looked too small for the job. It bumped and clattered around, but didn't look ready to break.

The waves had moved sand around capriciously, and exposed a rapid drop of almost a charter unit that necked down into a sort of natural chute producing a flow of three to four macrodoms per beat at a speed of a couple of charter units a beat. They had cut the curved paddles from a huge hollow *xo tar bin* log, the spokes from wave-felled *aspen,* and everything was held together with construction glue salvaged from the ruined station, and DCF. The generator told them it was putting out four eight-squared cues per beat.

The power line ran back to the cave to their dearly purchased power splice, to a communications transmitter, sitting under a mesh antenna retrieved from the ruined bioforming station. Drin knew the transmitter worked because his comset lock light said it found the carrier, but he couldn't listen in.

That couldn't be helped; since Mary's call had to be encrypted, but it was frustrating.

The log looked like it was trying to work its way to the right as it rolled. Drin grabbed a discarded branch in his beak and gave it a shove back to center. The green wood began to smoke from the friction, and the stench was awful, but things seemed to turn more smoothly. They'd have to shim the stone pile under the caster bearings as soon as Mary was done. Then they could recharge the vibrosaws and the comsets.

After a minor eternity, the lock light went out.

"Mary, I need to make some adjustments," he called.

"You've got about ten minutes for lightspeed delay. Then we wait. Drin," her voice was soft now, "If I don't get a call back in a couple of hours, I guess we can assume we'll

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get hit by the nets in the near future."

And they could also assume a dishonor polluting the highest levels of the Trimus Council, which would make a mockery of everything Drin believed in.

"Roger," he replied in low, disheartened tones. The whole damn Universe smelled wrong, he thought as he finished shimming the mount. That should about do it; he let the wheel run again.

A movement, almost behind his tail, registered at the limits of his peripheral vision. What? He turned to get a better look. What the polluting hell was that? A carnivore of some kind?

It reared up at the sight of Drin turning, and it looked big, even to him. The legs, covered with brown fur, looked almost as massive as his own. With his length he probably outweighed it by four-eights, but on its hind legs it reared taller than him. Its head was maybe only twice as big as Mary's, but most of that was a pair of heavily muscled toothy jaws that could probably crunch even his bones. Polar bear? But weren't they white?

Well, two could play the game. He bent his sore back slightly, lifted his tail as a counterbalance, and reared up himself, his beak rising to almost half a charter unit above the ground. He opened his beak wide enough to swallow the beast whole and waved his huge claw-tipped leg at it.

It stood still for a moment, claws floundering dumbly in the air, then yielded the display contest with a high-pitched grunt, dropped to a four-legged stance, and bolted in apparent terror.

Drin rumbled with laughter for a moment, then froze as it scurried right into the cave.

"Mary!" he bellowed. "You've got company. Get your piece ready."

She screamed. There were low growls, but no explosions. Drin was on all fours immediately and galloping to the cave as fast as he could through the still wet alluvial sand. He roared a desperate challenge.

Mary screamed again, and her loud pure high note augmented by awful dissonant screeches from Do Tor and Go Ton. The carnivore wailed itself, as if in pain.

Then Drin was under the arch. He smelled blood.

The cave and equipment were a mess. Soames was moaning; something was wrong with his arm. Then the thing turned to face Drin, and despite the difference in size, it charged him. Of course, he'd cornered it.

Drin whipped his tongue at it, branches curled into a heavy ball of cartilage and ligament, and hit it square in the head, sending it sprawling into the communications unit.

It had already been wrecked, Drin told himself, as he got his gun out of his pouch.

The thing was back on its feet and charging before Drin could bring the gun to bear. He couldn't snap his beak with his tongue out, and he was, just then, too off balance to hit it with a claw.

He tried to swing his open beak at it, missed, and it was under him, at his throat, biting incredibly deep for

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its small mouth. Drin groaned in agony, but finally rocked back enough to raise a front leg.

Then it was over. The upper half of the carnivore slammed into the ruined comset again, as fur, bone, entrails, and general gore splattered everything else in the cave, including Mary, Theric Soames, Do Tor, and Go Ton.

Drin gasped. He was pumping rivers of blood onto the cave floor from a throat artery.

He looked at Mary dumbly, thinking it might be the last time he would see her. She was busy, using only one arm, giving something to Soames. Do Tor had the vibrosaw. Mary grabbed the man's arm just below the joint. He looked at Drin as she held the torn stump out for what was apparently to be a crude surgery.

Drin tried to croak something, but Go Ton was talking to him trying to get his attention.

"Your ventral heart, Drin. Quiet it. They teach you how. Concentrate. Quiet it."

Yes. Think of deep, ice-cold water. Long endurance conditions.

"Good. Now, somehow you have to stay on your feet while this mess I work on."

Somehow, in the cave's wreckage, Go Ton had found the medical kit. The Kleth waded through the visceral garbage to get under him. A spray numbed his throat.

Drin realized he was woozy with heat. The charge to the cave, the fight, short as it was, with the carnivore. But if he fell now he'd crush Go Ton.

Cold deep water . . . negative buoyancy, standing. Drin locked his leg joints under him and let every other part of him go distant and quiescent. He stood, he endured.

How long? The dead alien flesh scattered around was beginning to smell. Finally, tugs on his outer hide told him Go Ton was closing the wound. At the last, a spray and a feeling of tightness. Smart fiber artificial hide.

"Done now," Go Ton declared. "Be more careful. Not enough for a wound that big again. Can lie down now, Go Ton will work on Theric Soames."

Drin backed away from the gore and settled into the cool sand. Unconsciousness came quickly.

Do'utian medical treatment offers several unique challenges to human and Kleth care givers. Foremost of these is the sheer size of the dose needed to do anything to a Do'utian. The principal means of providing Do'utian internal medicine is to use secondary vectors, biologically engineered bacteria that, when introduced into the Do'utian bloodstream in a dormant form, revive, multiply and give off the appropriate drug as a byproduct. Dosage is controlled by the preprogrammed number of replications allowed to each bacterium.

—Planet Monitor's Handbook,
Medical Appendix D

Drin watched Mary clumsily wipe the grease from her face with her right sleeve while holding a hunk of blackened meat. Go Ton had told him the two bones of her lower arm had

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snapped rather cleanly, and the surface wounds were deep punctures more than tears. With their limited medical facilities, recovery would be long and painful. For now, single branched Theric Soames was less disabled.

"Give it up, Soames," Mary argued. "I'll grant your ideals, but other people's ideals count, too. It was a hard decision, and sorry it didn't go your way. But your conscience can't dictate to everyone else."

Soames now stared at the dirt. "I'm not ready to admit . . . betray anyone else. I set the bomb. I hoped it would at least scare people into delaying things long enough that the political people could force another vote. I didn't want to hurt anyone. I tried to save Ko Kor's life."

"Huh?" Mary said. "Ko Kor wouldn't have lived."

"No, maybe she *would* have lived, if this egg sinks." Drin replied, realizing after he spoke, that the Do'utian idiom he'd translated might not mean much to his fellow monitors. A fertile egg sinks. "Never mind. Do Tor, what do you know about the Kleth that died, Ko Kor, and Sha Ton?"

"Besides being victims, not much. Deaths obviously incidental to attack on project."

"If Kleth are mates from the beginning, wouldn't they be born at the same time? In the same weather?"

"Oh, yes." Go Ton answered.

"Sha Ton's crest was notched, but Ko Kor's was smooth." Drin observed. "The implication being that they were not born at the same time or place, and thus not nestmates. But they were listed as nestmates. Why? And one had followed the other in death, like a nest mate. Why?"

The heads of both Kleth snapped up in unison and stared at him. Go Ton's eyes found her mate.

"You have seen what we could not." Do Tor finally said in an apologetic and formal tone, and in a respectful proper English that Drin was unaware the Kleth could speak, "We would never consider it because of our fear and denial of those few who do not share our first guilt. We shall check, but the records are very private. We shall need Council approval."

"Oh, yes." Go Ton chimed, very softly to her.

"Monitors," Drin rumbled. "I think Sha Ton's husband and sister are safe on Trimus, as are the brother and wife of Ko Kor. As parts of a triple, they would be expendable because they could die without killing anyone else, or continue to live if one or the other of them died."

"Oh, yes," Go Ton added. "And the conspiracy would keep their dirty little secret unless they betrayed the conspiracy. Lock in. Was too perverse for me, a Kleth to think of. Observant, suspicious, Drin had to spot difference in crests. Rest is reason."

"OK. I knew what they were, we were all part of it," Soames admitted, adding, "I thought I could save her before whatever was happening set off the explosives."

Do Tor lifted his wings slightly, a Kleth indication of irritation.

"But she did not want to be saved," Do Tor stated. "She had something

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more important to do."

"The cages," Mary said, at last. "*Canis lupus*, big gray, and hungry. *Ursus middendorfis*. Of course, the biologists had to be in on it: Wolves, bears, sharks, all enhanced, and none of them part of the official bioforming plan. What about the nets?" Mary asked. "Something to cover up the evidence?"

"I think Soames gets credit for too much." Do Tor said in the low resonant tone that indicated Kleth contempt. "He didn't know about nets, he was in open when they fell. Could have been *his* head. If he knew Ko Kor not going to die for mate, he knew for what she *was* risking her life. So that's what he tried to stop."

"Damn you, I was trying to save her life, bird brain!"

"Monitors, remember. These are criminals! Cheat Charter; cheat Council; cheat each other too. Sharks keep Do'utian primitivists out, wolves and bears keep humans out. Leave world for Kleth. Sha Ton was a rebel all his life, and I think wanted a world safe for Kleth triples. Soames, you wanted world for humans and not Do'utians—so you planned to bomb the baby wolves and bear. But the nets came and Ko Kor saved them for her partners back on Trimus before the electrical fires set off the explosives—if she didn't do it herself to save the conspiracy and hide tripleness. In a way, her death fulfilled a destiny she evaded at hatching, and perhaps that is how she saw it.

"Also, Earth birds, per unit mass, have best brains in whole strange Universe. Compliment accepted."

And deserved, Do Tor, Drin thought. But if Soames really didn't have anything to do with the nets, were they an accident? A wild card of fate? Or did someone back on Trimus know about them, someone placed highly enough to hide that knowledge and use it?

We who founded Trimus had a reverence for the past and our own natures. Perhaps this was nostalgia, or ancestor love, or the sensing of a dead end in the ultimate quest of the genetic engineers to fix everything. If we were clever enough, we thought, we could show, by three sentient species living together under a single law, that much of this change was unneeded; that we could preserve much more than others thought and still live at peace with one another. We knew we would have to work at it, but celebrated our common ability to act with reason over feeling. No one thought it would be easy, and we gloried in the challenge of these lofty heights.

—Go Zom's notes on the Compact of Trimus

With Aurum so near the horizon, the sky was again blood red. It could not simply be the low sun, Drin thought; there must be a lot of dust in the air.

"A volcano somewhere?" he asked Mary as they walked toward the river.

She laughed. "Of sorts. Drin, you guys, you just don't think about consequences because most of the time, you're too big to suffer ordinary consequences."

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"Consequences?" What did she mean . . . oh. "I see. Sea bottom turned to dust from the spacecraft explosion? Look, what would the consequences have been if I hadn't made a controlled detonation?"

Mary seemed to giggle and sob at the same time. "Controlled?"

"Well. . . ."

"Drin, sometimes you just don't have very good judgment abut things on my scale."

They had reached the generator wheel. Drin was moving very slowly now, and looked at the river below the wheel. There were fish in Do Tor's net, he hoped. He had to recover his strength, or the infinity in front of them might not last another day. The mission. Drin examined the transmitter; its input line, which had been attached to the ruined modem back in the cave, was a standard connector. He had trouble thinking; were power supplies standard? If not, they should be.

"I think if we could connect the generator directly to the transmitter, we might be able to send a digital signal. On and off, by interrupting the connection."

Mary patted him. "I'll go back and salvage a connector so we can patch them. Meanwhile, maybe you can eat something?"

"If it swims into my mouth. Which is not that unlikely, if I put myself in the right place." He yawned in imitation of a cave, with his tongue, branches and hands as bait. Mary laughed, and then she was off.

Drin turned to the water and slid in. He had a moment of exhilaration as the weight left his legs. Freed from that demand on his energy, Drin's body fed more blood to his head. His back still ached, but days on land had left those particular muscles alone, and while they protested, a few easy movements started to warm them up a bit, and what had felt so devastating seven Trimus days ago now seemed a nuisance. He let himself drift downstream. He hunted. He ate.

The wolf smell hit Drin as soon as he hauled himself from the water near the transmitter. No more good feeling; his protein-starved muscles burned with the pain of their reimposed burden. He should stay in the water for another day or two, but duty called.

He looked around. A large rock, maybe an eighth of a unit tall, stuck up from the sand about two thirds of the way from the cave to the river. The wolves were around it growling. From time to time the end of a large tree branch swung over it.

Mary? Drin pulled his gun out of his pouch, and felt a warning buzz along with the usual activation signal; only ten rounds left.

He keyed his comset, and got a warm-up signal. Pollution! He hadn't turned it back on since the recharge . . . too far gone, mentally, to check. It was on with checks complete in less than a beat, but that didn't do any good about the past. "Mary, I'm back. Is that you in the wolves?"

"Drin," her voice was shaky, "Drin, I'm out of rounds; but they don't know that, so they're being cautious."

"I'll try to get to you, but I can

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barely move."

"I don't dare run to you. First thing I show any fear and they'll be on me."

"Where are the Kleth?"

"Go Ton's looking for you. Do Tor's watching Soames. We got worried."

"Sorry. My comset was still on recharge. Do Tor, forget Soames, we need some firepower."

But it was Soames's voice that answered. "Too late for Do Tor to forget me. And if Go Ton tries to help, I'll blow his head off."

Pollution! What had happened in there? At least Go Ton was, apparently, still alive. Best leave that problem to Go Ton when she returned.

"I'm coming, Mary. Not very fast, but I think I'll make it."

"OK." She replied. Drin saw the stick jerk down and heard a yelp.

He heard wings overhead, and stuck his tongue out and made the monitor sign for silence. Go Ton alighted just ahead of him.

"Heard, Lieutenant," she said.

"Load trank; you'll have to take him. Good hunting."

"Loaded. Front door, full speed. Good hunting, Drin."

The Kleth leapt into the air and gained altitude. Eight charter units up she stooped, buzzed the wolves surrounding Mary, sending one yelping away, then headed for the cave mouth at a speed that only Kleth reactions could envision.

Meanwhile Drin got close enough to shoot at the wolves.

"Mary, I'm in range. Can you run?"

"Like a deer. Of course, that's breakfast for these things."

"If you can spiral in toward me instead of running right at me, that should keep you out of the finder range and give me a clear shot."

"Got it. Regards to Mom."

She, Drin realized, didn't expect to make it either.

"Mary Pierce. For whatever it means, I love you too. Now run while I can still stand."

The stick descended once more, and this time Drin heard a howl. Then Mary sprinted from behind the left side of the rock. Three wolves were right after her.

In a fraction of a beat, Drin shot once, and one went down. But the others didn't seem to notice. He shot again and a second went down, but the third lunged at Mary's leg.

It got a shoe in its face, and a bullet before it could recover.

Four more wolves leapt over the bodies of the fallen.

Drin pressed the stud down and five rounds went before he released it. Three wolves down, one stumbled over the other two, and was joined by four more. Drin had two bullets left.

A roar of frustration left his throat, as he shot one, getting one wolf in the midst of a leap at Mary. Too close; the bullet could just as easily have locked onto her.

The wolves stopped and looked at him.

He roared again, this time putting a little anger in it, and stepped forward. One of them yelped, and they retreated, milling around, sniffing their dead.

Mary sprinted to about three charter units of him before the wolves

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realized Drin wasn't going to charge them. Then they came after her again. She tried to run faster and tripped, struggling though the soft, wet sand. Drin moved slowly, painfully forward, but he was too far away.

Suddenly, for no apparent reason, one of the wolves screeched and started biting at its own rear leg, apparently biting it off entirely. The whine got the other's attention and they milled around yelping and sniffing bodies.

Something hissed in the sand beside Drin.

"Mary, NETS!"

The front part of a wolf's head fell off, leaving a blood-spurting howling horror. Compassion used Drin's last bullet as Mary reached him.

"Get under me," he said and turned toward the river. His fight and flight glands were in full gear, but they had almost nothing to work with; his muscles were burning their own tissue, slowly. He felt a vicious sting on his back.

Mary scrambled under his head. The water was eight squared charter units away; the antenna, its mesh reflector an ironic reminder of what was falling on them, was within six eights.

The mission. They should try to save it, the transmitter, and the generator.

The tip of his tail burned. Amputated.

"Mary, where do these polluting things come from?" he groaned as he staggered on.

The question was rhetorical, but to his surprise, she answered. "Not Trimus, we think. Do Tor took our sample apart while you were gone, with the med kit. They look grown, not designed. But it could be that's what we're supposed to think."

Another sting on his back.

"Are they dispensed? How do they move?"

"They're very light absolutely, but still much denser than air. They wouldn't reflect light like light sails, unless there was stuff between the membrane that burned off in aerobraking."

Four charter units to the equipment. A net brushed a leg, slicing deeply. He stumbled a bit.

"Watch it, guy," Mary said, forced calm in her voice. "Uh, they could reflect radio waves, just like our mesh antenna. As long as the radio photons are bigger than the mesh openings."

Radio waves, like any other electromagnetic waves, exert pressure, Drin thought and the nets were very light. And the mesh was actually about the same size as their antenna's.

"Do you still have the connectors, Mary?"

"Yes."

They were at the equipment and the nets hadn't hit it yet. "I'm thinking we can levitate or deflect them with enough power."

"That sounds a lot better than me trying to carry this stuff with one arm. I'll try to get the flywheel going."

Drin's first reaction was that he should do that and she should make the connections. But on the end of his tongue he had two hands available, and she didn't.

The lines to the cave—he would

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have to cut them sharply and cleanly to put them into his connector but he didn't have a tool. He cast his eyes quickly around the machinery for anything he might use. There was nothing.

A net might do the trick, but ironically, there wasn't one handy just now. Or was there?

In his back.

He opened his beak and looked at the gun. It had a diamond barrel, with a raised fixture for attachments on the end. He bent around and looked at one of his fresh new scars, put the gun barrel in, pushed his flesh aside, then pushed the barrel down in, twisted it and pulled it up again. It hurt, but not enough.

He did it again, and this time was rewarded with the feeling of having surgery, without anesthetic. He couldn't help groaning in pain, but when it was done he could see, glinting in the horizon-reddened light of the now-rising Aurum, the thread of a net.

He grabbed the output line, pulled what he hoped would be enough of it back from the direction of the cave, draped the collapsed net over the cable, and gently sawed back and forth.

It cut through the glass cord sheath like a diamond-edged vibroblade, and he stuck the cleanly severed end into the connector. A net burned the top of his head, slicing the sensitive area around his blowhole. Shaking with weakness and pain, he repeated the procedure with the other cable.

"Mary," he called, "turn it loose!"

The wheel creaked, the generator telltales went on, the wheel went faster. Drin tried to think; power, lightspeed, the constant of To'ictillig, photon pressure—it all blurred.

A net hissed into the wet sand behind him. He moved nearer to the dish and looked up into the gray, deadly sky. Aurum peeked through the cloud cover again and its low golden glow caught a net glinting far above him. He backed away, but then noticed that it seemed to slide away.

He lost sight of it, but then saw a brief plume of steam where it must have hit the sand a charter unit away. He caught another brief plume farther away. One hit the wheel and hissed.

"Drin, I think it's working," Mary shouted over the noise of the wheel. "The nets are avoiding us like we were in some kind of force field."

Drin lay down in the cool, wet, sand and started taking long deep breaths, too exhausted to even reply. Soames, Do Tor, Go Ton, the nets embedded in his hide, and all the other problems; even Mary faded in relief. Safe for the moment, his body reclaimed him.

A day later, Drin felt much better; his meal had worked its way to the rest of his body, Go Ton's trank rounds had easily subdued the slow moving and surprised Soames, Mary seemed her old self again, and Do Tor thought he knew what the nets were.

"The webbing is a thin diamond alloy tube only a few thousand atoms across," he said. "Not quite monofilament, but when it is very hot, it cuts almost as well."

"Oh yes," Go Ton added as Drin

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grunted his own ironic concurrence.

"High temperature but not much heat," Do Tor continued. "Water, flesh, wet wood, and sand stop it in a doci or less. But it goes easily through bone, plastic, glass, composite. Nets receive, transmit, or reflect radio waves at fairly high efficiency, depending on what the nodes that connect the webbing do. Possibly Ember is radio-bright enough to push them away, so they don't fall on Trimus."

Net falls, Drin remembered, had occurred a few hours after use of the high powered communications.

"Then," he speculated, "the deaths were not a crime at all, but an accident? They seem too convenient."

"Can't tell if they are artificial or naturally evolved, but they seek mini-unit radio sources—what we use. They could be deliberately attracted."

"By who?" Drin asked. But it was becoming all too clear. All the threads had a common connection, one he wanted to reject, that he didn't dare voice.

Before anyone could answer his question Mary's comset beeped for attention. Who?

"Hello. Mary Pierce here, go ahead."

"This is Spacecraft *Trimus Compact,* on approach. Captain Loren speaking. You should see us shortly to the west. We have an ecological team, Councilor Olsen, and Gori'allolub aboard."

Drin's beak went to the sand at the omission of Gori'allolub's title. Whether the others noticed it or not, that immediately told Drin the worst of his fears had been confirmed. He would almost rather not be rescued.

They saw the spacecraft first, a tiny teardrop against the gray clouds. Then a single heavy sonic boom rattled back and forth from the cones of the nearby volcanoes. A slipstream roar followed the boom, and finally a cracking torrent as the spacecraft engines scaled up to full thrust, allowing it to settle gently into a billowing cloud on the sea beyond their river mouth.

Macrovirus is a name applied to various self-replicants which, absent anything sapients would recognize as intelligence or ability to communicate abstract ideas, nevertheless have evolved the ability to travel between stars and feed. Five are known to be spreading in this part of the Milky Way Galaxy, and only one poses a significant threat to a prepared population. But, in surprise, all are dangerous.

—Planet Monitor's handbook,
Off-Trimus Section

The great Do'utian, Gori'allolub, did not lower his beak, and presented himself with the presence of a beachmaster. That, Drin thought, presented a memorable contrast to the circumstances of his speech. In sadness Drin, lowered his own head as Gori'allolub spoke.

"So I must take full responsibility and ask for gentle treatment of Theric Soames. I believe, and continue to believe, that transport to Aurum III simply delays confronting our problem and needlessly sacrifices an entire

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world. To do this in a way that flowed in the direction of strengthening the Compact required risking the lives of dedicated people, lest our network became known before it was too late. Now, I must make amends and attempt to do something that will allow the future to face the problem in accordance with the wishes of the majority of the Council, including my most intimate friend whom I have wrongly betrayed."

"Two Kleth dead, even if tripled." Go Ton spat, as angry as Drin had ever seen him.

"Gori'allolub has resigned from the Council," Councilor Karen Olsen added, unsteadily, it seemed to Drin, "to take charge of the biological reengineering effort. Even though I supported resettlement, I should have recognized the depth of his opposition and done more to achieve real compromise. So I take some of the blame and am staying here with him until the job is done."

She gave a tight smile, and when she did so, her resemblance to Mary startled Drin. Most intimate friend, Gori'allolub had said, yet on opposite sides of a hard political question . . . was this possible? Drin's beak opened as he tasted the wind—as if he would find an answer there. And there was an Earth strangeness to Gori'allolub's smell.

"Now to more pleasant things," Karen Olson nodded to Drin. "There is a Do'utian slot on the Council open. The Kleth and Human members have voted to nominate Monitor Lieutenant Drinnil'ib. I think there is little prospect that the Do'utian members will veto this."

"What!" Drin blurted, then quickly put his manners together, and touched his beak to Karen Olsen, "I mean I am honored. But politics? I do not swim in those currents."

The Councilor laughed. "None of us do, at first. But you have the needed dedication to the Trimus Compact and Charter, a far better education than most, and a considerable popular following from your, shall, we say, exploits."

"Oh, *YES*," both Do Tor and Go Ton sang.

Drin dug his nose almost a doci into the sand trying to think of something to say.

Do Tor came to his rescue.

"Excuse. I assume we are now safe from nets, but would like more than assumptions."

Oh, yes, Drin thought.

Karen Olson nodded. "Very safe. We saw what you did from our satellites, and have the orbital Aurum III comm maser deflecting the stream to Aurum II for now."

"Why are they here?" Drin asked, "A macrovirus, I know. But using the term explains nothing."

"We think the nets were initially attracted by the electronic noise at the start of bioforming activity, almost a macroyear ago. Unfortunately, a scientist involved with resettlement opposition found the nets and saw a way to cover the tracks of the conspiracy. They kept the nets a secret and used Aurum III's satellites to lure them here."

"Knowing that Ko Kor, Sha Ton, and I would get killed?" Soames

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whined.

"Sacrifices are necessary burdens of office," Gori'allolub said. "You chose the risk."

"And our investigation?" Mary asked quietly. Drin could sense incomprehension in her voice.

"You," Gori'allolub stated, "were expected to be delayed, to discover the external threat too late, but not the conspiracy, nor to counter either threat quite so effectively. I badly underestimated your abilities, Drinnil'ib." Gori'allolub added. This time he did tip his nose slightly. "That all four of you would survive sabotage, three net falls, and two antimatter containment loss events defies reasonable prediction."

The tone of Gori'allolub's remark suggested that Drin had done Trimus a disservice by staying alive. With a start, he realized that this must be just what Gori'allolub felt, and that below the reasoned discipline the ex-Councilor smelled not unlike a bull chased from its harem.

"I meant you no personal harm," Drin hissed politely. "You assigned me to seek the truth."

"I asked you to quiet troubled waters, not roil them," Gori'allolub growled. "Now, I must apologize for putting myself above the Council. As I am sure you know, exile is an insufficient apology for causing useless deaths."

"Gori'allolub? " Karen Olsen asked.

Did Gori'allolub want to lure Drin to beach combat? In his present weakness, Drin would surely lose and the huge Do'utian could eliminate the others by "accident!" Was that the problem with the other's smell? Had he taken chemicals to disguise such a challenge scent until too late?

"There is only one sufficient apology."

"No," Karen Olsen protested. "Time heals all such wounds."

"Silence." Gori'allolub snapped. There was a whiff of challenge, but Drin forced his beak down.

"I will not fight you, master." Drin stated, fighting down his own challenge instinct.

"Do not become too human, new Councilor," Gori'allolub hissed, "or you will lose the people's support. Think of Trimus as a tripod, not a sphere mapped with three regular identical colored areas, and you will do much better. No, you do not smell disguised challenge. I have ingested chemicals that will sterilize any sharks that eat my flesh. Karen, if I have failed you, I did so for a higher loyalty; just as you failed to support me in Council for a higher loyalty. So our fun was meaningless. Now, I am going for a swim with the sharks that I helped to bring to this world."

With that Gori'allolub turned and began walking in a measured, dignified way, toward the river.

"Gori'allolub," Karen Olsen shouted. "No. You don't need the Council. I will love you here, give you joy. We can still swim together. Gori'allolub, you are my life!"

Mary stared at her mother, mouth gaping. Drin's head fell. So Gori'allolub himself had drifted in the same strange currents that tempted Drin. How little he really knew the great one. But he knew this much; now

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only the balm of the most hideous sacrifice would lay Gori'allolub's pride to rest.

"He has no other choice," Drin told Karen Olsen quickly, "to still be a Do'utian and honor his commitment to Trimus. Providence ends all life eventually; let him go now, in balance."

"Where is your medical kit," Karen quickly asked Go Ton, "show me the anesthetics."

Go Ton held the case open and indicated the row. There were hypos and dart gun ampules. Karen took one labeled: "Do'utian: Male."

"Mary, give me your gun." Mary complied. Drin understood and made no move to stop her—it would make no difference to Gori'allolub's honor if others forced the pain blocker on him. Karen loaded the gun, and gave it back to Mary.

"You know what you're doing, Monitor. Shoot."

Mary leveled it at the Do'utian's neck. The acquisition light blinked and she shot. The dart knew to find its way to that same area of thin hide that had caused Drin so much pain with the bear wound. Gori'allolub ignored it, but now he would be able to contemplate his dismemberment free from the distraction of pain.

Mary faced her mother.

"Mom, I understand. I wanted to tell you that I have been thinking of having the same kind of relationship with Drin. I don't understand, really, the fascination I have for it. But it's something really basic. I don't feel bad about it, and I think I can handle it. And let go if I have to."

Councilor Karen Olson nodded and laughed in a way with which Drin was not familiar. Higher pitched, a different feeling. "After five centuries, Mary? You think you can handle it? Then consider this." She took a hypo tube from the open kit. Drin could read the label: general pain blocker, human. "It was a really fine perversion and I am *not* quite done with it." She stabbed her arm with the injector. "Wait, Gori. It is only my life at stake now, and I will not leave you."

The big Do'utian hesitated but a moment, then resumed his march to the sea, the sharks, and his completion. Drin understood. The old one was leaving all the affairs of Trimus, including Karen Olsen, behind him as a defeated bull leaves his harem to another without looking back. Should he say something?

"Mother," Mary cried, "you're not a harem cow or a Kleth mate! Human beings don't do that. How can we respect their identity if we don't respect our own?"

"You don't know, child," Karen Olsen snapped, and without a further word, fled after Gori'allolub.

It was a life versus a reputation, and Drin could not remain silent. "Councilor Olsen, he used you. He used you to get Mary's codes to try to endanger our lives. He used her communications with you to send the nets at us, twice. He's not worthy of this loyalty!"

At this, Gori'allolub did turn and roar in rage. Councilor Olsen stopped and backed away from the two Do'utian bulls. Drin's hearts began pumping at combat strength, and he

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took a step forward. So they would both die.

Then, with the slow majesty of one winning a hard fight with himself, Gori'allolub turned back toward the sea.

Karen Olsen looked at Mary, shook her head, and set out again after Gori'allolub.

"No!" Mary shouted and ran after the Councilor. Drin saw that Karen Olsen was too far ahead to be caught by her daughter.

But not by Drin. He shot his tongue out to its maximum length and just managed to wrap both branches around the fleeing human woman, who struggled briefly, then collapsed and sobbed in his grasp as Mary ran to her.

And with that one gesture, which he would remember for the eternity ahead of him, Councilor-to-be Drinnil'ib crossed the line from enforcing the choices made by others, to making such choices for them. He resolved that he would try to do so responsibly and reasonably, for Mary, for Do Tor and Go Ton, and for all the Trimusians in his wake. ■

Editor's Note: This story is set in the same system as "Poles Apart," in our Mid-December 1992 issue.

Life itself is the proper binge.

Julia Child

The greatest of faults, I should say, is to be conscious of none.

Thomas Carlyle

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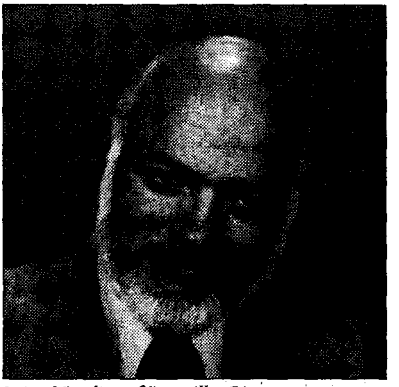
BIOLOG Jay Kay Klein

Gerald David Nordley's assortment of overlapping educations, jobs, and directions in life customary for a science fiction writer have been overlain by twenty years in the U.S. Air Force. Not a hot-shot pilot, but the very model of a modern major military manager, Gerald retired with this rank after running the Advanced Propulsion Branch of the Air Force Rocket Propulsion Laboratory. Dr. Robert Forward worked there under contract. Antimatter propulsion and exotic chemical methods looked promising enough to form a separate group, which Gerald managed under a civilian Ph.D. Asking him about what came of all this gets you a blank look.

Born and raised in Minneapolis, Gerald received a BA in physics from Macalester College in St. Paul. Later, there was an MS in systems management from USC at Los Angeles. USAF staff courses were taken along with literature and creative writing classes, including the Silicon Valley Writers Workshop under old-time *Analog* author Algis Budrys.

As a lieutenant, Gerald started out managing satellite network navigational data exchange to determine orbits of newly launched spacecraft. Eventually, he became chief of the whole orbital operations branch before moving to spacecraft development engineering. Since retirement, he has continued writing papers on astronautical engineering and remains a member of the British Interplanetary Society and American Institute of Aeronautics and Astronautics.

Gerald David Nordley



Bristol Studios of Rossville, GA

Gerald brought this background to a concentrated effort to become a full-time science fiction writer. A first sale took two years, with "The Snows of Venus" in the May, 1991 *Analog*. "Poles Apart" won the 1992 *AnLab* for best novella/novelette. He seems prouder of this than the commenda-

(Continued on page 158)

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THE ALTERNATE VIEW G. Harry Stine

THE EMPIRE OF TECHNOLOGY

The word "empire" used to mean a political unit, often comprising a number of territories or nations, ruled by a single supreme authority. Today, it has a broader meaning: it is an extensive enterprise under a unified authority. Its Latin root is the word "imperium," meaning to command.

I hear a lot about interstellar empires in some science fiction stories, TV shows, and motion pictures. As empires in the classical sense of being unified political entities, an interstellar political empire is probably an anachronism. It's nothing more than a bit of story-telling fluff left over from the fairy tales we heard as children and snippets of quickly forgotten ancient history that was a boring scholastic subject. Without faster-than-light or "subspace" communications, the information transmittal delay precludes a large interstellar empire. Ask any systems engineer.

Even Cyrus II, the ruler of the fifth empire in history (Akkad was the first, followed by Egypt, Assyria, and Babylon) knew that communication was the glue that held together his far-flung domain. So he built the Royal Road from Susa to Sardes along which post riders mounted on fast horses carried his written orders to the outlands and hard copy reports from his satraps.

Thus, I maintain, empires have always depended upon and utilized the best technologies of their eras.

And could not exist without technology.

And in fact did not exist very long when confronted by other political organizations having superior technology.

Even religious fervor cannot glue an empire together. Nor can ideologies. These factors can provide the instigation for the formation of an empire during its early years. But they cannot stand up to superior technology.

We have two recent historical examples.

(Please understand that I am not taking sides for or against any religion or a specific religion itself. I do not intend to imply here that one religion is better than another or that any religion is trivial. We all have our religious beliefs. If these keep us happy or give meaning and direction to our

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lives, no one else has the right to challenge them. When this has happened in the past, whether as a real cause of conflict or a convenient excuse to kill hated neighbors, it has led to a lot of bloodshed. It still does. Witness Bosnia-Herzegovina, for example. We can get along without such deadly conflicts in a world that appears to want to trade and build market economies. Armed conflict is now being viewed mainly as an anachronistic means to attain power over people, energy, and materials. Basically, to a trader, war doesn't "pay" any more. As Heinlein pointed out, most of us want to be able to forge better lives for ourselves and our children without a war joggling our elbows every few years.)

In the year 610 A.D. the Eastern Roman Empire and the Persian Empire, with the help of the remnants of the White Huns known as the Avars, found themselves occupied in a fruitless and costly war with each other. Therefore, they paid no attention to what was happening in the town of Mecca in Arabia. There, Mohammed had his first revelations from God by way of the angel Gabriel. In the years that followed, his acolytes proceeded to carry his message to the rest of the world, and this meant the use of force in the form of *jihad* or holy war. Although the Koran forbids the forced conversion of anyone to Islam, the object of the *jihad* was to gain political control. This was necessary to eliminate the priests who wouldn't abide the Islamic religion. Driven by ideology, the Arabs conquered an empire that spread from Spain and northern Africa across the Middle East to southeast Asia.

China was an introverted, xenophobic culture that created some of the high technology of the era but didn't apply most of it. The Roman Empire had collapsed under the weight of excessive taxation to support a mercenary army for defense against the growing ravages of the Asiatic nomads. The great Roman cities had been depopulated by an ancient flight to the suburbs as people ran from the tax collectors. The Eastern Roman Empire, later to become the Byzantine Empire, hung on partly because it was better organized and had good internal lines of communication.

The tongue-twisting Islamic caliphates became the centers of learning and technology for the next eight centuries until Europe woke up again.

The Islamic Empire really wasn't a political empire at all. It was an ideological one. But it was a real empire nonetheless. From Morocco to Makasar, the language of Arabia was spoken and understood, much to the dismay of local cultures with their own heritage. However, Islam didn't demand conversion, just submission. Subjugated peoples were only expected to pay their taxes and behave themselves; they weren't required to believe or practice the Islamic faith.

Islamic technology was better than any at the time and may even have been better than we understand it was today. As discussed before, technologies can be forgotten or ignored because the need for them disappears

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or never emerges.

But Christian Europe began to expand and push on the Islamic Empire from about 1400 A.D. onward, challenging the dominance of this ideological empire by both direct confrontation and physical outflanking.

Europe was evolving into a marketing culture that is still evolving around us today. It was difficult to do business with the Orient. Overland trade was prohibitively expensive except for luxury goods. Most of the trade went by sea and involved an overlapping series of transfer and shipping nodes involving Egyptians, Arabians, Indians, Annamites, Indonesians, Chinese, and Japanese. Each added fees and charges to a shipment. The Islamic states once controlled both ends of most trade routes between the Mediterranean and the Orient.

The growing commercial empires of the Europeans—the Portuguese, Dutch, Spanish, Venetians, Genovese, and even the Hanoverians—saw that control of an entire trade route was essential if profits were to be maximized. This meant building a commercial and military empire. But they didn't have it and didn't look like they could achieve it.

To an impartial observer looking at this situation 500 years ago, the place to bet your money was on the might and extent of the Islamic Empire, not on the upstarts of Christian Europe. A solid wall of Islamic countries stretched between western Africa and southeast Asia. This was expanding south and east. The people of the Niger region were adopting Islam; so were those on the east coast of Africa. The nomads along the Asiatic silk route were turning to Islam as were islanders of Indonesia. The Christian enclaves of Georgia and Abyssinia were dwindling in size and importance; they had never been a threat to Islam but had been too expensive to conquer and rule. In fact, Christian countries everywhere were too weak and militarily backward to match the armies of the Ottoman Turks, for example. No Christian group could offer any serious military challenge to Islamic armies.

From the viewpoint of geopolitics, geography, population, and almost any numerical statistic you would care to name, Islam was the wave of the future in 1400 A.D.

Except for one thing: The increasing communications technology of the Europeans combined with a more efficient way of managing people, which is also a technology.

The Europeans had an alphabetical script and the technology of moveable type printing combined with a technology for the mass production of paper. They were more efficient, faster, and more widespread with their communications. The European countries, even with different languages, were literate and, as a result, multi-lingual (as they are today).

A growing legacy of European technology—growing because its increasing data base could be rapidly and easily communicated—allowed the Europeans to simply roll over the Islamic nations. The sultan stumbled over the type slug.

The second of our examples is the

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former Union of Soviet Socialist Republics, the USSR.

Fifty years ago, a serious forecast by intellectuals who were historians, anthropologists, sociologists, economists, political scientists, and philosophers would have indicated that the USSR was the clear choice in the confrontation between communism and democracy, the ideological opponents of the twentieth century. Communism had apparently transformed a backward, illiterate, bumbling bunch of peasants into an industrial empire that took on Germany and won. The USSR produced the best tank of World War II as well as the only dedicated ground attack airplane, the *Sturmovik*. The USSR had enormous natural resources including iron, coal, and petroleum, the materials that lie at the base of the industrial infrastructure. It had a huge population base that had sustained a loss of an estimated 35 million people in the Great Patriotic War (World War II) and hardly made a dent in the demographics. Communism had apparently worked and was the wave of the future.

However, its basic failures were hidden by the Soviets because their philosophy said that they should reveal to their enemies only the information that benefitted the Motherland. Or these were ignored by those in the West who felt seriously threatened by the antagonistic Russian bear because for two thousand years the nomads of the East had swept over and ravaged Europe. The critical shortcoming was the absolute and total control over people exercised by the leaders of the USSR. Control of people includes control of access to and transmission of information. The internal communications of the USSR were tightly under the control of the state. Soviet people knew only what the Soviet government wanted them to know, and people could communicate to others only what the government wanted them to communicate.

The Soviet telephone system was at the root of this. No telephone directory was ever published in the USSR. If you didn't know the telephone number of someone with whom you wanted to talk, you couldn't even make the connection in the first place. As a result, the telephone network existed solely for the use of the Communist Party, the KGB, and the Red Army. Soviet communications technology slowly fell behind that of the rest of the world because it was limited. It was limited because the USSR was rich in resources but poor in management abilities. The late Herman Kahn described the USSR as having a "short blanket economy"—e.g., when the shoulders got the blanket, the feet got cold. The Soviets simply had all they could do to keep what they had working.

An example of communications poverty will show why this is so. I recently participated in a private interactive teleconference. This technology is an integral part of corporate America, and the corporate techs *have* to keep it working. But this was a recreational teleconference where the technicians' jobs didn't depend on keeping the technology working. And they didn't have adequate facili-

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ties to communicate with one another. During the conference, the incoming video signal went away. Only two telephone lines were available and they were dedicated to the audio and video signals. However, the local techs managed finally to get in touch with the major node of the system through a cellular telephone. When informed at the node that the video signal wasn't getting through, the technician there said he'd fix it and promptly hung up. He kept squirting video signals down a dead line, not knowing whether they were getting through. Subsequent attempts to reach him produced a busy signal because everyone else on the net was having the same trouble at their ends.

A commercial television network has hundreds of dedicated channels (lines) and technicians on both ends who are in constant communication with one another. They have a lot of personal feedback in their communications. They keep the system working by switching signals from line to line and fixing or replacing equipment that has somehow gone toes-up.

The Soviet Empire—and it was an empire in the physical, political, and ideological senses of the word—came apart because the bear tripped over the microchip. Ideology, religious fervor, and even authoritarian control couldn't maintain its cohesiveness. It couldn't compete with the rest of the world because it couldn't maintain the level of rapid and multibyte data communications demanded of an empire today. The Soviet Empire's information handling (that includes communications) technology was overwhelmed by that of the Empire of Technology: us.

The Empire of Technology isn't just the United States of America. It's the whole wired world. I can make a touch-tone direct-dial telephone call to almost any country (provided they publish telephone directories or I know the number of the person). I can send documents via facsimile to any place a telephone system exists that's wired into the world. I can do both anywhere within range of a cellular telephone facility, too.

I've seen the Motorola Iridium equipment that will, in this decade, allow anyone anywhere in the world to get into audio, video, fax, or modem contact with anyone else. The Motorola Iridium system uses a network of low-orbit satellites and doesn't need hard wires between the satellites and the hand-held ground transceiver. I'm very pleased to see this because I forecast it 20 years ago.

It's being backed up by (or is the back up for) the fiber optics system that's now hard-wiring the world together. This broad bandwidth system will handle multi-channel duplex transmission such as two-way interactive high-definition television, computer communications, and good old voice-only telephone. (We'll keep the good old voice-only telephone. Who wants an active video phone staring at you when you first get up in the morning, to say nothing of other delicate times?)

The Empire of Technology is real, and it isn't going to go away. In fact, it's evolving. As the old TV saying goes, "Stand by for continuous coverage. Tape at eleven." ■

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ASHTRAY
CHILDREN
When you gain great powers, you can do great damage, or you can shrink from using them to avoid that risk. But those aren't the only choices. . . .
Illustration by Todd Cameron Hamilton

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So long ago. So long ago. And yet, looking into these enormous brown eyes I remember as though it is but yesterday. The sweet 'bama sun, and the June breezes on my face, and the cool grasses thick beneath my feet like God's carpeting. Yes, I remember it all too well; all I need do is close my eyes, and drift a moment or two, and I am there. . . .

Late twentieth-century Earth. A tiny place, but full of troubles: crime, disease, poverty, hatred, riots, Los Angeles, Saddam Hussein, the Middle East, oil, fire, greenhouse effect, ozone depletion, global catastrophe, AIDS, nuclear weapons, overpopulation. . . .

My biological family was poor even by the standards of the time, trashy poor some would say though we never knew it, never thought that way, were proud of what we had and did. Pa worked in the ball bearing factory all day, ma did housecleaning and other odd jobs when she could. There was enough to eat, a roof over our heads, a school and a church. Especially a church.

I can still see that church clearly. A vast crumbling eggshell of a structure, high up on a hill, gazing down on us like a portrait, watching you wherever you went. Every Sunday the folks packed us off, and one by one we walked the dusty road up the hill and filed into the great eggshell where we sat. A sea of noisy black faces on silent white pews, and listened to the Reverend Stetson tell us about God and Jesus and the hereafter and the faith of little children.

Faith was the central element in our lives, the fulcrum about which our lives turned. I know that is difficult to believe, or even to imagine now, but it is true. Faith was our air and water and food; it burned in the hearth, and sent smoky tendrils up into the stratosphere. It was our wire into the cosmos. It vibrated in the walls of our beings. Pa came home every evening coated with it, a grime that no amount of soap and water could ever quite wash off. Ma beat an upbringing into us with it.

Sitting on his lap, looking up into those moist old eyes. I was five or six, maybe younger, small for my age but nanorazor sharp even then. He knew it too; and I knew it from the expression in those eyes, the way he saw opportunity and danger at the words that had just come from my mouth—I knew I had asked the forbidden question.

"You must find Jesus in your heart," he answered it; "you must open your heart to him, and then He will fill you with His love. That is the only way you can know Him; the only way to Heaven. There is no other way."

I've cheated you, the accusation screams through my head, like a cry of damnation. But the brown eyes are still on me, still innocent, trusting, still moist with expression. Mine are filled with tears.

I was the youngest of seven, or eight—or was it nine? That I don't remember clearly anymore. Also the brightest. Maybe it was my brother and sisters beating on me too. Whatever, I got a full scholarship, got

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packed off to the University. Hugs and kisses from everybody, including the Reverend Stetson himself, now a doddering old man. Myself, I was seventeen.

Could I really have been seventeen once? It's a misty dream to me now; no, a nightmare in a swirling fog: *urban warfare, deindustrialization, MacPherson, Green Revolution, animal rights, tuberculosis and smallpox, desertification, global cooling, mass extinctions, Moscow, South Africa, Kotube. . . .*

And yet in the midst of all this now inconceivable carnage, flowers did bloom in the desert. Remember cancer from your history plugins? This was when it was at last licked for good. And a host of other genetic slow deaths. Other important developments to recall: the first permanent space station, a return to the Moon, the commercialization of fusion power, the first practical human-computer interfaces. Of course it seems like hell now, it *was* hell, by any standards, but a few rungs of the ladder were climbed. More importantly, *we* climbed them.

My major was engineering, with minors in astronomy and electronics, not a common combination even then but I'd always had my own ideas. I'd grown up in an isolated backwater of a world, and when I realized there was more I wanted it. Joined the National Space Society, the L-5 Society, you name it. I was determined for a career on the High Frontier. Ma didn't understand of course; she thought it was my duty to spend my life improving the lot of those "down here, where all th' needin' 'n' suff'rin' is; why, there's nothin' 'n' no one up there to help." Reverend Stetson just shook his head sadly, and said he'd pray for me.

Pa wasn't there. The bearing factory had shut down a year ago, replaced by robots in Korea or Mexico or some place like that, and the government had sent him to a school in another state, to learn computer programming on twenty-year-old machines that nobody used anymore. I never saw him again. I assumed he was at last with God.

I was on the first International Mars expedition in 2016, just before the first big breakthroughs in age control. We stood on the ocher sands and looked into the twilight, and felt a billion years and an entire cosmos leech into our bones. Earth was a tiny, if still tragic, sapphire in the sky, the Moon a tinier diamond beside it. There are moments in each life that remain fresh with you forever; that was one of mine (as, of course, is the one now). The expedition had cost a trillion dollars, about 5 percent of the GWP, but any fool could see that it had been worth it; at that moment seven billion faces were gazing up at hope instead of down at their troubles. It was a moment that set the pace of mankind for centuries to come. I wouldn't have traded it for all the gods in all the scriptures.

I stroke the furry face before me, and curse myself for having thought that thought. *I'm sorry.*

We could have stayed in orbit. We could have contented ourselves with looking down with our telescopes

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and probes and sniffers. We would have learned just as much, and they would never have known.

But we couldn't do that. No, we have to be God. Of course, we don't tell ourselves that; we persuade ourselves instead that we are doing them a great favor, in showing them what is possible. That they will take hope from our example, the same hope those seven billion took so long ago. But deep inside, we all know it is a fraud. We know they wouldn't see it that way. And that that is the real reason we came down—to be worshipped. God damn us all to hell.

I returned from the Mars expedition to learn that Reverend Stetson had passed on to his reward. A heart attack in the middle of delivering his Sunday sermon. He was eighty-two.

Ma had just reached her sixtieth year herself. I comforted her—I tried to comfort her—by talking about the future, about the developments going on in the genetics laboratories: "In another decade they'll be able to reverse the aging process in humans completely. You'll have eternal life—and eternal youth." But ma was horrified at such a prospect: "All mah life I been gettin' ready t'meet the Lord, 'n' now you want t'take it away from me? What's matter with you, boy?"

I tried arguing, until I realized it was hopeless, that this person had spent her entire life preparing for the day she would face her God, and that to steal that moment was to steal that life, too. That I had no right to such a theft. That night I cried like a baby, cried myself to sleep for the first time in as long as I could remember.

That was the last time I ever went home, at least physically. Talents like mine were needed elsewhere than on a minuscule planet, especially one so long on problems and short on hope. I spent the next half century expanding and developing the new empire: L-5, Mare Imbrium, Cydonia, the Belt, Ganymede, the Rings, Triton.... I was a planner, a builder, a solver, a trouble-shooter (and maker), an explorer and a rogue. And I was successful everywhere, at all of these. Successful and happy. I became famous. I forgot where I had come from. I forgot everything.

It was glorious and exhilarating and an awful fat lot of fun, but of course it didn't last forever, couldn't last forever. For at the edge of every frontier is still another frontier, and the spirit inevitably yearns for that too. Yet—the stars! Even the closest was ten thousand times farther away than the farthest distance I had yet traveled. It was a journey I could not comprehend. Even immortality seemed too short a time to cross those gulfs. But cross them I would, of that I had no doubt; I just did not know how yet.

The moment they came bounding out of their huts toward us we knew we had made a tragic mistake. *We're the answer to their prayers;* the realization, at once undeniable and irrevocable, flashed through our minds. We didn't even have to look at each other to know that all had picked up the thought simultaneously.

Perhaps if we had been expecting

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intelligent life . . . but that had been the furthest thing from our expectations when we'd entered their system. After all, didn't the experiments of Barkley and Bleigh prove once and for all that life—even at the simplest level—was so improbable that it would not occur in more than one in a million galaxies? And didn't the Fermi Paradox (if intelligence were common in the Universe, it would have come to us long ago) confirm our solitude? Where, and how, had we so badly miscalculated? Or was it just our misfortune?

Our misfortune?!

To the α*Centauri* system and back was a little over seventy years that first time. When we got home, we discovered that Earth had finally solved her population problem, thus her resources problem, once and for all. For by then space for sentient minds in the net was essentially infinite, and people who still wanted families could raise virtual ones to their hearts' content.

Many did, as well as live other lives fulfilling to them, but for us it was an empty life, devoid of—of—to tell the truth, we could not have told you what it was devoid of. All we knew was that if mankind had solved all the problems, had conquered all the dangers of living in the Sol system, then that system was not the place for us anymore.

We needed faster starships. We needed to press as close to the light barrier as possible. No, not really; with our infinite lives, and youths, it shouldn't have mattered how long it took us to fill the Universe. But matter it did, terribly. For we were still human though our bodies no longer were, all too human, with minds sculpted by millions of years of natural selection to think in terms of years, or decades at most. We were far too impatient in the pursuit of what gave us joy. So we labored toward our dream.

And succeeded.

A thousand years later. It still seems like eternity to us, when we think it out loud. Yet it is but an eyeblink: *Homo sapiens* (to the extent we can still be called that) is but one half of one percent older; the Atlantic Ocean has widened another part in a hundred thousand; the Sun has completed one four-hundred-thousandth of its orbit about the Galaxy. We have touched some ten thousand systems, yet a hundred times that many lie within our reach, and ten trillion times that sum lay beyond. It is only arrogance that makes us feel old.

We should have known better. The moment we saw the tiny sapphire, and the tinier diamond beside it, we should have stopped, pulled back, and reached into our stores of wisdom. Hell, we should have been on our guard the moment we entered the system: a G2 single, age approximately three billion years, low angular momentum, metals, an Oort cloud. The fact that we'd been through a hundred similar systems should not have made us lax.

But it did. And when we tasted water in all three phases, we lost our grip on reality. We swooped in for a closer look. When we found free

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oxygen and chlorophyll, we dove closer still.

And found them.

The sculpted hives of vegetation, clustered around lakes and river deltas, were clearly visible from orbit. Through the scopes we could easily make out the mud and straw huts, and the dirt roads they traveled on.

They are much like us, in many ways. Forget the fur, and the six fingers (including fully opposable thumbs) on each of six limbs, and the short stubs of tails no doubt left over from their tree-dwelling ancestors. They're still eggheads, with (big!) binocular eyes and faces that glow brightly with intelligence and curiosity. It will take time to completely decipher their language, but its complexity is instantly obvious in the richness of vocabulary and bodily expressions. Their emotions range the spectrum, from simple fear and anger all the way to humor and reverence (don't ask me how—you can just tell, that's all). And if all this isn't enough, then know that at night they sit and gaze at their moon—larger than Earth's—and the stars and wonder, and argue.

Yes, they are children, but in another ten thousand years or so, they will be where we are now.

Excuse us, for a moment I forgot. But looking into those eyes reminds me again, with stark cruelty: *would have been where we are now.*

Lord, can you forgive us?

Where would we be now, if ten thousand years ago, or even a thousand years ago, our gods had descended from the sky, and touched us with their reality? Of course, maybe they had. Maybe that is why the journey had taken ten thousand years. And so many billions of lives that might have been spared. We have been too content to sit back and wait for salvation to come to us.

Where would ma, or pa, be now if. . . .

No; you're evading your own guilt. The present.

The brown eyes gaze softly into mine, the most innocent of trusts. I'm not sure why, but I reach out again, and touch that face with crooked fingertips, as though I could reach right into the mind and pull out memory of what it has experienced today, as though I could make it forget.

Do not despair, young one.

I pull away, touched by the lightning of the thought. My breathing is suddenly fast, and ragged. "What . . . ?"

It says nothing, but takes my hand and places the fingers carefully against its temple and forehead. *There, that's better. Soon you will not need physical contact, perhaps in another million or so of your years, but it is not a great encumbrance for now. It is even comforting, in a way.*

"How—who—did you say a million years?"

A day in the lifetime of the cosmos. Which, as you have chosen me for the honor, allow me to welcome you into. Your first steps were certainly exciting to watch!

I try to say something intelligible, but my facilities fail me.

Oh come on, you didn't really think

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we would allow you to make such a terrible mistake, did you? We didn't allow it to happen to you, and we would never permit you to do it to another species. No, these beings will reach adulthood just as you have, by their own glorious efforts.

Adulthood?

Well, let us say, provisional adulthood. Adolescence. You've made it. Congratulations. Your folks must be proud of you.

Before I can react to that statement, I am standing on God's carpeting, with the Sun on my face and the soft breezes in my hair. I am not alone; ma and pa, and Reverend Stetson, are beside me. I am seventeen.

"This is cruel!"

Limited perception always is. That, too, you will outgrow.

I am on ocher Martian sands, a pair of worlds at my fingertips.

Faith has sustained you this far. But now it is time to move on. Your first responsibility. I am back with reality again, the warmth of fur upon me. *Here. Making sure they don't run around with scissors, or put things in their mouths, and learn to share their toys. Discreetly of course. You know how to do that....*

Strangely enough, I do. More important, I am ready. ■

You must do the thing you think you cannot do.

Eleanor Roosevelt

Just because we have dawn and dusk doesn't mean we can't tell the difference between night and day.

Kelvin Throop's Guide to Science Fiction and Fantasy

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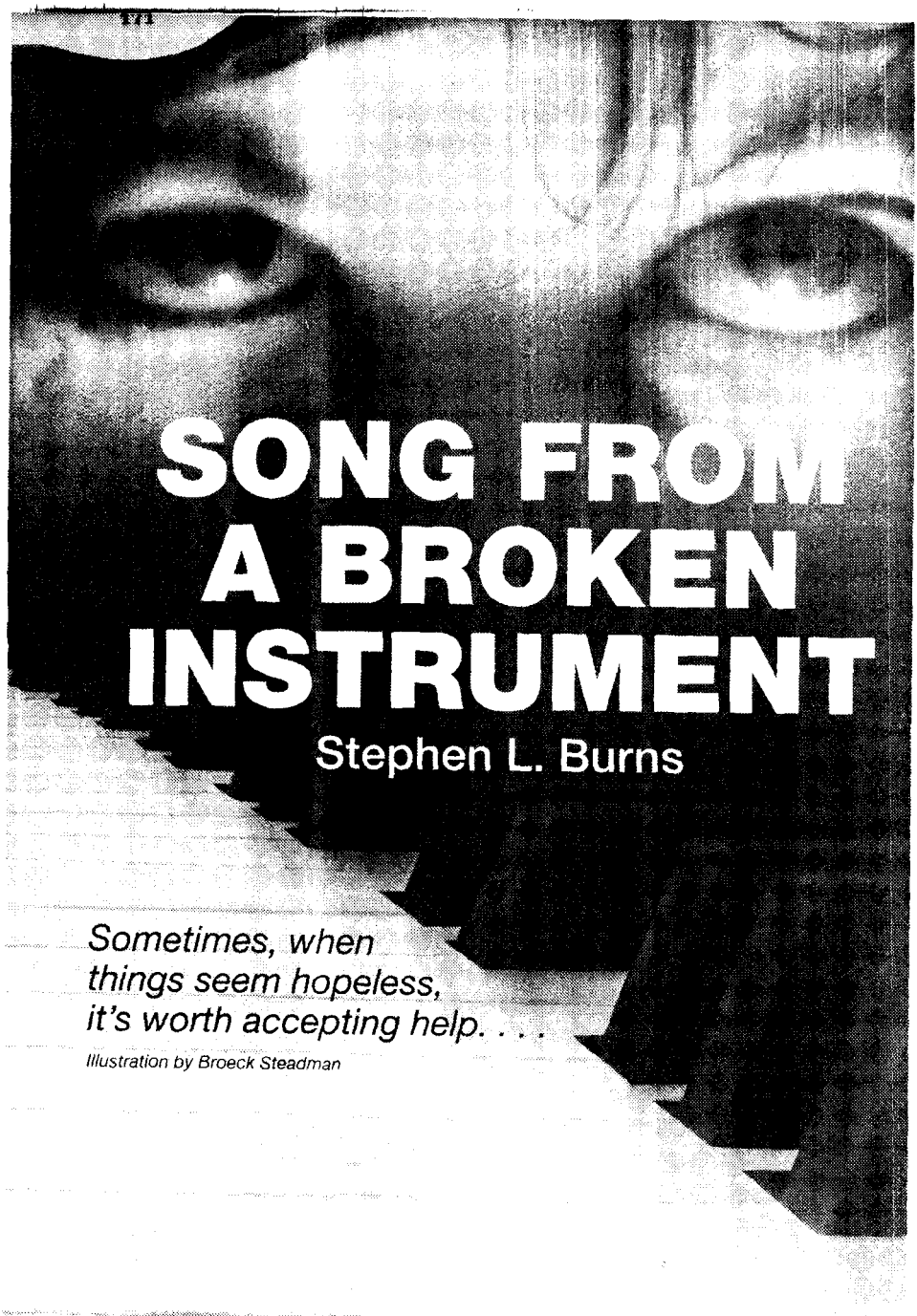

SONG FROM A BROKEN INSTRUMENT

Stephen L. Burns

Sometimes, when things seem hopeless, it's worth accepting help. . . .

Illustration by Broeck Steadman

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This year they were calling it *Grammy 2000.* The spangled and sequined thousands gathered for the awards ceremony rose to their feet as Topaz Baldwin made her way up onto the stage. The applause was thunderous, almost deafening, mixed with cheers and whistles.

A petite woman with skin the color of burnished bronze, she walked toward the glass podium at front center stage with her back straight and her head high. On a night when most had obeyed the dictum of Dress to Excess, she wore a simple open-necked white silk shirt and loose-fitting black silk pants. On her feet were a pair of battered red Keds. Clipped to the red beaded belt at her waist was a black leather covered object about the size and shape of a Walkman.

She reached the podium, and looking a little overwhelmed by the continuing ovation, gazed out over the crowd with dark eyes that sparkled with emotion. A nervous smile edging onto her face, she pushed back an errant wing of the curly, glossy black hair that cascaded onto her shoulders and down her back. Her smile was beautiful. The combination of a black father and Vietnamese mother had lent her wide face an exotic cast; she looked more like the product of Polynesian sands than the Minneapolis suburbs she had grown up in.

The audience finally returned to their seats as she reached up to adjust the microphone.

But she did not bend it toward her mouth.

Instead she pointed it at the silver filigreed, square-cut black pendant hanging at the base of her throat. She patted the device at her hip like an old friend, then began to speak. . . .

February 3, 1999

Gray-lit eyelids too heavy to open. A great muddy river of pain inside her. Hollow, distant voices. Lurching motion—

Although Topaz Baldwin did not become fully conscious as she was being wheeled from the operating room, she regained a brief, groggy state of interior awareness. It lasted only a few seconds, scarcely longer than the time it took the gurney to pass through a set of swinging doors, but that was long enough.

She *knew.*

Usually such fleeting moments of awareness or comprehension would be described as the flare of a candle in the darkness.

This was just the opposite. In an instant a small sweet source of light and heat was ruthlessly pinched out, leaving behind only a charred and smoldering wick.

Her throat constricted to let out a wail of horror, anguish, and denial. A cry that would have shattered glass and driven a spike of ice into the heart of anyone who heard it.

Dull pain bloomed inside her, a damp skyrocket in a heavy fog.

Not even a whimper escaped her.

She collapsed back into an inner abyss, her silent scream fading away to nothingness, the blazing trail of a falling star as it cuts a final dying line in the endless night sky.

The moment the nurse entered the

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small second-floor nurses' lounge she was using, the big spike-haired woman hunched in a chair with a pocketphone at her ear and an unlit cigarette in her mouth looked up hopefully. The nurse nodded.

"I'll call you back," Cass Morgenstern said, snapping the phone shut, unplugging her cigarette, and standing. Even without the scuffed cowboy boots on her feet, her big-boned frame would have easily topped the six and a half foot mark. She squared her broad shoulders, staring down at the nurse.

"Well?" she asked gruffly.

The nurse smiled. "She came through just fine. No complications, and her vital signs are strong and stable. Dr. Braddock would have come in to tell you himself, but he was called in on another emergency."

In the space of a single moment several expressions crossed the blunt landscape of Cass' face. It was a square, rough-hewn face, strong jawed and heavy browed. Not exactly masculine, but not soft enough to ever be called pretty. She grimaced, banishing all but a frown. "Can I see her?"

"Well, she's in her room now, but—"

"But what?" Cass demanded harshly, stepping closer and drawing herself up as if to grab the smaller woman and take her apart one piece at a time to get the answer.

The nurse paled but held her ground. "But it's going to be several hours before Ms. Baldwin regains consciousness," she said gently, reaching out to lay a hand on Cass' arm. "You've had a rough night, Ms. Morgenstern. You should get some rest."

Cass shook her head, her shoulders sagging. "Honey," she said wearily, "The rough part hasn't even begun."

Topaz slowly awoke to the smell of rubbing alcohol and flowers. Barely able to move her head. One arm numb and immovable. Strange unpleasant pressure in one nostril.

The first coherent thought to pass through her head made her wish she had never awakened. She remembered. She *knew.* A crushing self-knowledge that could only be measured in tons descended.

When she opened her eyes the first thing she saw was Cass. Her manager.

Ex-manager, whispered a bitter voice in her head.

Cass looked like hell, her face pale and drained, deep bags under her eyes, the moussed spikes of her brown hair drooping into question marks. She leaned closer, trying for a smile and only partially succeeding.

"Hey there Taz," she said softly, her low, throaty voice even raspier than normal. "Welcome back."

Topaz had no way of knowing how long she'd been out of it. Judging by the way Cass sounded, it had been quite a while. No doubt she'd passed whatever time had elapsed on the phone. Cass used her phone the way a juggler used her hands: keeping all those spinning plates in the air.

Well, the crash had come, and she really didn't give a damn if Cass picked up the pieces. There was no way to glue them back together again,

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anyway.

Cass gave that smile another shot, her big square chin firming up and her wide mouth nearly managing an upward curve. "You're going to be all right, darlin'. You gave us one hell of a scare. . . ." She shook her head. "But you're going to be all right now."

Topaz stared back up at her expressionlessly. Somewhere inside her the Taz who loved Cass like a sister yearned to comfort her friend. Elsewhere another Taz wanted to shriek at her *Stop lying!* She was *not* going to be all right, it would have been better if she'd died. Both remained silent, smothered in numb misery.

The memory of the attack was etched into her brain cells as precisely and indelibly as the pits cut into the surface of a laser disc. The sight, the sound, the smell, the taste, the feel; all recorded with unforgiving digital clarity.

You never answered my love letters!

—Leaving the radio station after taping an interview promoting the new album. Late afternoon drive-time jocks Sam Stun and Delilah James, Eddie Rickert the program director, and Sherri Esposito the promotions manager going down the elevator and out onto the street with her and Cass. Sherri carrying a minicam to shoot a ten second video spot *(Hi there New York! Topaz here! Don't forget, I'm always in town on WAPL FM!)* out on the street, taking advantage of as kind an early February day as the Big Bad City gets. Warm sun on her face. Herself out in front. Feeling good. Cass hanging back for some last minute schmoozing with Eddie and the jocks about rotation. Play those songs—but not too often. Don't oversaturate. Have the listeners *hoping* to hear them again, not dreading it.

The tall man in the army surplus trench coat appearing before her out of nowhere. Stubbled face. Crazed eyes. Sour sweat. Another street crazy, right?

Wrong. *Dead wrong.*

He screams as he comes at you, spittle flying. *You never answered my love letters!* Reaches into his coat—

Cass had let out a yell and rushed to protect her, but too late. Too late.

—Or too early. His second blow had been aimed at the side of her head and would probably have homerunned it right off her shoulders. *Louisville Slugger.* She could remember recognizing the logo in a kind of detached amazement as the ash bat came whistling toward her the first time.

Horrible crushing impact, nearly knocking her back onto her butt. Staggering, dropping to her knees. Fingers clawing uselessly at the fire in her throat. A fire spreading to her lungs. *Can't breathe!*

Her throat felt raw and swollen, throbbing with sullen pain. It was still hard to breathe, but nowhere near as hard as knowing there was no point to it.

She stared up at Cass, her gaze flat and dead. Inside she felt empty, a piano gutted of its hammers and strings.

Cass' almost-smile fragmented. "Oh Jesus, Taz, I'm sorry," she whispered in a low, desperate voice. "I tried to stop—I couldn't—" She shook her

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head from side to side, baffled. Her big square hands opened and closed, helplessly seeking some place to grab hold and turn things around. To turn back time and try to move a little faster.

Topaz found that she could still feel dismay when she realized Cass was blaming herself for what had happened. That made its way through the numbing caul of apathy into which she had been reborn.

She opened her mouth to tell Cass it wasn't her fault.

A small, ugly sound came out. The sort of sound someone choking on a chicken bone might make. It was barely audible, but it froze them both like a bloodcurdling scream.

The physical pain it set off was dulled by drugs, still it felt like a chunk of red-hot asphalt had been dragged up her windpipe. But that pain was nothing compared to finally hearing what was left of what she'd once had. The first subsided, but the other echoed on and on and on.

"God, Taz, don't try to talk!" Cass begged, snatching up her free hand. "Please."

"She's right. Please don't try to, um, speak," said somebody off on her other side.

This new voice was thin and reedy. Topaz rolled her head away from Cass and toward its source. A short, chubby, stoop-shouldered man in baggy green scrubs and an oversized white coat stood in the hospital room's doorway. Thick-lensed granny glasses perched on his snub nose, magnifying watery blue eyes. A shaggy head of ginger hair stuck up in every direction.

"That's Dr. Braddock," Cass explained. "Best throat surgery specialist in the city. He operated on you. Saved your life."

Braddock looked down. "Actually your, um, manager saved your life," he mumbled. "I just did some, ah, repair." He came into the room and approached her bedside diffidently, looking unsure he really belonged there. "Sorry it took so long to get here."

After first giving Topaz a tentative smile, he probed the thick bandages swaddling her neck with long delicate fingers. "Are you OK with how much this, well, hurts?"

Topaz replied with the ghost of a shrug.

"It's going to. You took one hell of a, ah, whack."

The sense-memory of it whispered through her, making her shiver. Braddock opened his mouth, probably to tell her what he had done to her and how. Topaz pulled her hand free of Cass' grasp and held it up. *Wait.*

"Yes?"

Although certain she already knew the answer to the only question that mattered, she went through the motions and asked it the only way she could. She put her hand to her chest, then swept it outward, opening her mouth wide at the same time.

Braddock looked pained. "The blow crushed your larynx. Three years ago that would have meant it had to be, um, completely removed. I was able to, well, sort of *uncrush* it instead. But to do so I had to remove your vocal cords."

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Topaz stared at him, wordlessly demanding that he finish pronouncing her death sentence.

He shook his head sadly. "No," he said, his thin voice gentle but firm. "You won't be able to sing again."

Knowing it had made her feel like her life had ended, but hearing it said out loud had the chilling finality of a coffin lid slamming shut over her. She turned her head to stare up at the ceiling. His words rang in her ears as she closed her eyes, willing Cass and everything else to go away. She gathered up a bight of blanket in her free hand, trying to hold on.

After a minute she heard Braddock's soft, apologetic voice. "I think maybe we should, um, give her some time alone. Let her sleep."

She heard Cass sigh, then felt her hand close around her fist. "I'll be back later, Taz. You hang in there, kid. Try to rest. We'll beat this somehow, I know we will."

Her hand was released. She heard them leave the room.

She bit her lip, eyes squeezed shut so hard they hurt.

You won't be able to sing again.

There was no keeping back the scalding tear that broke free from one eye and burned its way down her cheek. More followed it.

Topaz cried herself to sleep, weeping with the arid silence of a dry riverbed mourning the chuckling, tumbling waters which had once filled banks now doomed to dust and memory.

A Voice is Silenced

Sylvester Byrne, special to *USA Today*

If you are going to write about popular music here are two things you must be able to do:

Find gold among the dross.

Write eulogies.

When it comes to gold among the dross, the disproportionately high percentage of the best music of the last half of this century has come from women. They have given us works of honesty and originality, works that touched the heart and tested the limits and tickled the brain. Works which have, and will, continue to stand the test of time.

Some of these women have become famous. Others are appreciated only by a discerning few. The best art is not always the most popular.

When we lose one of these artists, these voices, the world becomes a poorer place, no matter if it is thousands or millions who mourn.

The singer, songwriter, and musician Topaz Baldwin had earned her place as one of the brightest lights in this constellation. Critically acclaimed from the very first, she has over the course of seven albums come up from a life of club-dates and crumbs to gain a comfortable level of fortune and fame. A wider audience and bigger money can be the artistic kiss of death in the music business, but Topaz avoided that pitfall by never letting her music—or herself—become product.

Just thirty and at the top of her form, her career promised to be long and brilliant. All that ended when yesterday, one of the darker trappings of fame got her.

I was eighteen and working for a college newspaper when Janis Joplin died. It was then that I wrote my first eulogy.

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In the many years since I've had to practice that sad craft far too often.

But how do I write a eulogy for an artist who still lives?

I am certain you have heard by now that Topaz was attacked yesterday afternoon by a demented fan, a man named Charles S. Norlitz. He screamed at her that she had not answered his love letters, pulled a baseball bat out of his coat, and struck her in the neck with it. Cassandra Morgenstern, Topaz's manager, tackled the man and prevented him from delivering a second, perhaps killing blow. I am certain you know about this tragic event because Topaz's modest fame, and the fact that the station's promotions manager caught the whole ugly event on tape, have guaranteed a firestorm of publicity.

Ms. Morgenstern saved her client's life a second time. Partially trained but never qualified as an EMT, she pinned the singer to the sidewalk, cut a hole in the base of her throat with a pocketknife and inserted a soda straw. That straw allowed Topaz to start breathing again, and kept her breathing until an ambulance arrived some ten minutes later.

Thanks to those heroic acts Topaz is still alive. In a short statement delivered by her manager and a hospital spokesman early this morning, we learned that she is in stable condition. But a description of her injury and the surgery she underwent made it painfully obvious that she would never sing again.

Topaz was much more than just another female vocalist. Her fluid, distinctive piano and synthesizer playing is unmistakable. Because of it she has been voted *Keyboard Magazine's* Player of the Year four out of the last seven years.

Every song she has ever written and recorded has been crafted with intelligence and passion and precision: *Storm; You, My Love; Moonbather's Rhapsody; Cold Hard Hand of Rape; My Robot Self; All Fall Down*. A dozen or more other songs spring to mind. Yet as good as her songs are, they are rarely covered by other recording artists.

That is because no one could sing them better. Topaz had the sort of voice that comes along only once in a generation, a voice of uncanny range and flexibility. While in it one can hear echoes of such disparate artists as Barbara Striesand, Kate Bush, Joni Mitchell, Patsy Cline, Enya, and Aretha Franklin; her voice was hers and hers alone.

Now that voice has been cruelly silenced.

I hope she continues to write songs. If she keeps on showing us life and love through her eyes we will all be a little less blind. If she continues making the music she alone can make the world will be a little less discordant.

The voice of Topaz Baldwin has been stilled, and yet I hope it is too early to write her eulogy. I have this feeling that only she can help us endure the silence.

Cass dropped the paper across her knees, let her head slump back and closed her eyes. She made a mental note to give Sly Byrne a call. He'd managed to put into words some of what she'd been feeling and unable to express.

—Help us endure the silence.

Seeing Taz attacked had scared the hell out of her. Seeing her flopping helplessly on the grimy sidewalk like a fish out of water, strangling to death

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before her eyes had scared her worse than that. Putting a knife to her throat and willing her hand to bear down had been scarier yet.

But seeing the hopeless emptiness behind Taz's eyes had made all that seem like mild anxiety. It had taken every ounce of strength and courage left in her to face it without flinching.

Cass knew Taz better than anyone else in the whole world. She'd seen her come unstrung before, like when both her parents had died in that plane crash some four years back. That had been bad, but nothing like this.

She had gone past despair and into a far odd place Cass had seen once before. That same look had been in Nat Brolin's eyes shortly after the bassist's HIV had turned into full-blown AIDS, and just days before he'd killed himself with a massive overdose of heroin. Nat, a Mr. Clean who wouldn't even take aspirin.

Was Taz capable of doing something like that?

Just a day ago she would have laughed and said *No. Never.*

But that was then and this was now. That schmuck with the bat had started a whole new ball game.

Cass sighed, rolling her aching shoulders. She still hadn't slept, and couldn't remember ever feeling this tired. Her brain felt bruised and stupid, her emotions ground down to gravel.

A glance at her watch told her it was late enough in the day to call Nevada. It was time to ante up or fold.

She heaved herself out of the chair with a groan and helped herself to yet another cup of the bad coffee from the pot set up in the nurses' lounge they were letting her use as an office. Making a face at the first bitter sip, she carried it over to the window and parked a meaty hip on the wide sill. After opening the window and lighting a forbidden cigarette she pulled her phone out of her pocket and placed the call.

It was a long shot, but if she was going to be forced to endure the silence it would only be after she had done everything in her power to break it. Starting *now.*

Topaz leaned back against the pillows, staring dully at the device propped against her thighs. She had to peer down over her nose because the thick padded collar around her neck prevented her from tipping her head forward.

Called a talkboard, it was a putty-colored steel-cased keyboard about the size of one used with a desktop computer. The letter and number keys were of the standard size and layout. Above them was a long strip of red LED readout. On the right, in place of a numeric keypad, was a toggle marked WORD/SENTENCE, a sliding volume control and a black-grilled speaker. On the left, instead of function keys were twenty square touchpads, each labeled with a single word.

It had taken the aide who had brought it to her less than five minutes to show her how it operated. He'd left only after she'd promised to practice with it.

She tapped one of the touchpads

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on the left.

"H-elp," it said in a soft robotic voice.

Both her arms were free now, and she'd spent half of her life working with a MIDI setup. Touchtyping was a breeze. She hammered four keys in quick succession, then hit SPEAK.

"Sh-it," the talkboard said tonelessly, carrying none of the emphasis she wanted to put behind the word.

A nurse came out of the room across the hall, leaving the door open behind her. Topaz's skin prickled as that released the sound of her own voice, coming from a radio in the room.

"When the storm finally passes—" her voice sang in a rich deep contralto above the dying rumble of drums as her piano, acoustic and electric guitars, and a violin emerged from the thunder like clear blue sky from behind dark clouds.

Topaz squeezed her eyes shut and shook her head from side to side. The mocking sound of her voice beat at her ears like a bat into flesh and bone. It hurt. *Hurt.*

"—And the sky begins to clear—"

She tried to cry out but only a thin, nasal keening sound escaped her. Hardly a sound at all.

"—We gaze into each other eyes—"

She stared at the talkboard on her lap, searching for the pad she wanted, punching it. "St-op," on the board responded tonelessly.

"—And it's then we realize—"

Her frantic hands found the volume control, jammed it all the way forward to maximum. She stabbed her finger down on the pad again, held it down.

"St-op. St-op. St-op. St-op. St-op," the board repeated in an idiot monotone, louder now, but nowhere near loud enough to drown out the hateful hurtful sound of her own voice.

She knew the part coming, remembered how great it had felt to nail it down on the very first take in the studio. The phrase *We're still here,* begun as a question down in the black velvet lower registers, turning to dawning amazement as it climbed though her middle range and all the instruments fell away below, soaring effortlessly up through soprano to a note so high and joyous and triumphant it shimmered like a star in the silence. A killer note—

—Forever beyond her dead voice now. A hiss of rage and pain and denial ripping from her aching throat, she flung the talkboard across the room. It crashed into the ranked pots and vases of flowers set up on the table opposite the foot of her bed, knocking them down like tenpins, the eloquent sound of shattering glass blotting out the cruel reminder of what she had lost.

In the other room the mocking sound of her voice died mid-note as the radio was snapped off.

"Are you all right in there?" A woman's voice called uncertainly. *"Are you all right?"*

Topaz wrapped her arms around her head, huddling around the despair churning inside, knowing she would *never* be all right.

Cass had been delighted to learn

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that Dr. Braddock had a secret vice. He smoked cigars.

Upon entering his office she'd been greeted by a thin blue haze layer that hung in the air despite an opened window. Braddock had apologized and offered to put his cigar out. "Are you kidding?" she asked, breathing a weed fiend's sigh of relief as she lit a cigarette and sat down. "I finally get to burn one without feeling like a goddamn criminal."

Braddock chuckled as he returned to the chair behind his untidy desk. The smile he gave her looked as tired as she felt.

"Sorry it took so long to find time to, um, talk to you. I had another emergency surgery right after your, ah, girl, then rounds, then—well, I've been kind of busy."

Cass blew a stream of smoke into the air. "So I've heard. You look like you belong home in bed. I won't hang you up long, Doc. There's just a couple things I want to talk about."

"Take your time, Ms. Morgenstern." He gestured with his cigar. "I plan to um, finish this before I go anywhere."

Still, Cass wanted to get right down to business. "Taz isn't doing too hot," she said heavily. "Losing her voice stomped her flatter'n gum on a shoe."

Braddock's stooped shoulders slumped even lower than normal. He rubbed his stubbly chin, then peered slantwise at her through his thick round lenses. "What, um, time is it?"

Cass checked her watch. "A couple minutes after five. Why?"

Instead of answering he ducked down and began rummaging through his desk drawers, at last resurfacing with a quart bottle of Wild Turkey and two paper cups. "I believe you and I have earned a snort, um, Ms. Morgenstern."

"Call me Cass, Dr. Braddock," she said, liking this disheveled little man's style more all the time. It was even her favorite tipple.

"Dr. Braddock is off duty. I'm, um, Sid." He poured a liberal portion into each cup, then pushed one across the desk toward her. She picked it up, saluted him with it, and knocked it back in a single gulp. After a moment's hesitation he did the same.

"Thanks, Sid," she said when it hit bottom. "I needed that."

He grinned at her shyly, his eyes watering. "You earned it. Like I said before, you saved her life, um, Cass. Intubating her like that took one hell of a lot of, well, nerve."

"You're telling me. I just about turned my favorite Victoria's Secret ecru panties yellow doing it. I started EMT training a few years back, but had to quit when we went on tour. Kept up on my reading, though. But do you want to know what really pulled me through?"

"What?"

"That 'M*A*S*H' rerun where Father Mulcahy had to do the same thing. I saw it on the tube last week while I was waiting for Taz to finish an interview." She snorted. "I guess that makes me a TV doctor." Although she made light of it, remembering putting a knife to Taz's throat made her insides clench and her palms break into a sweat all over again.

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"I believe you still have to do an aspirin commercial to, ah, qualify for your degree," Sid explained as he refilled their cups. He slumped back in his chair. After taking a tiny sip he met Cass' gaze. "I agree with you. She has not taken this well. I've ordered passive monitoring around the clock in case she tries something, um, rash. As for that incident this afternoon, well, I suppose I should've expected a rock star to break up her room."

"She's not a rock star," Cass corrected automatically. She made a face. "Sorry. Pigeonholing is the kiss of death in the music business."

"None intended." He inspected the glowing tip of his cigar. "I've been trying to imagine what it must be like for her. Losing the ability to speak is a devastating blow in and of itself. She has lost not only that, but something even more precious."

He shifted uneasily, still not looking at her. "I'm quite familiar with her music. She sang like a bird flies. There was an ease, a *rightness* about it. When you heard her you knew it wasn't just something she did, but what she *was*."

He blinked up at her, blushing slightly. "If you, um, know what I mean. . . ."

Cass smiled back at him. Taz's music left its mark on people; she probably knew that better than anybody. She had to wonder if it was the Wild Turkey making his speech less uncertain, or that old Cass Magic. That was one of the curses of her life. When she wasn't into ball-busting bulldozing manager mode, people—well, *men*—found her comfortable.

Like an old overstuffed sofa.

"Believe me Sid, I know. I've devoted the last ten years of my life to making sure Taz could sing and play what she wanted, the way she wanted, when and where she wanted. I've fought record labels, A&R men, radio programmers, concert promoters, publicity flacks—I've gone toe to toe with anyone and anything that tried to get in her way. . . ."

—And so far I've won every time it counted. . . .

Cass felt the tears which had been building up since the moment of the attack trying to come on once more. Those were something no one was allowed to see. *No one.* She was Cass Morgenstern. Hard as nails. She knocked back the double shot left in her cup to pull herself together. Braddock waited patiently, eyes averted and puffing on his cigar.

"Let me tell you a story, Sid," she rasped, leaning forward and helping herself to a refill. "Once upon a time, in the bad old days before National Health Care, I worked the bottom line for a private hospital system. I was doing my best to help turn health care into a highly profitable luxury commodity and make the good old US of A an awful place to be sick if you were poor. They called me the Terminator. I had an MBA and a BMW and I was on my way up the corporate ladder, each rung a pile of bodies."

Her voice dropped lower. "Then I met Taz. She was playing at this dumpy little club a lawyer friend of mine owned as a tax sump and private hunting preserve for nookie. I heard her and I was, well, *moved*. No

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backup. No lights. With nothing more than her voice and her words and a beat-up old electric piano she reached right out and broke my smug little world into pieces.

"I asked my friend about her. He laughed and told me he'd hired her just a couple-three days before, and already she was packing the place. Best of all, he'd been able to chisel her down to thirty bucks for three one-hour sets each night. He was so *proud* of himself, like he'd found a cure for cancer or something.

"Well, when her first set was over I screwed up my courage and asked her if she maybe needed or wanted a manager."

Cass stared past Sid, through the window behind him, looking back to a night she could still remember more clearly than she could remember any day of last week. "We sat at the bar and talked. When she went back on stage to do her next set I sat there and listened, getting scareder and scareder by the second. All I could think about was how I *had* to be a part of what she was doing. It wasn't like I was thinking *I can get rich off this chick*, it was like I found Jesus and had to become a disciple. When her last set was over we talked until closing. In the end she told me I could be her manager—if I could prove I understood the things we'd been talking about."

Cass lit a fresh cigarette. One part of her wondered why she was telling him all this, but another knew that it was so he would understand precisely where she stood. Braddock waited for her to continue, radiating a patient interest that helped her go on. He was a good listener. She couldn't remember the last time she'd shared any of this with anyone.

"Taz has some . . . limitations. She's terrible with money. She's incapable of keeping to a schedule on her own. Her love life has been one disaster after another—nearly as bad as my own. One thing and one thing only is important to her, and that's *her music*. That first night she told me the music always had to come first. If she made money, fine, but she had no intention of cashing in on fads or gimmicks, or having her tits and ass be what people came to see. If I wanted to be her manager I had to prove I understood that. So I did."

Braddock raised his shaggy ginger eyebrows. "What did you do, Cass?"

Few men would ever call Cass Morgenstern pretty, but the radiant smile that dawned on her face made her beautiful. "I met her at the bar that next night, sat her down at a table, put my MBA in the ashtray between us and set fire to it."

Sid guffawed, slapping his hand on the table. "Beautiful. I take it that did the trick?"

Cass nodded. "That was the beginning of our partnership. By the end of her first set that night I'd nailed my schmuck friend to the wall and gotten her $200 a night starting that evening and for the rest of the week, and $400 a night if she decided to grace his dump with her presence a second week. Within two days I'd given all my Dress for Success suits to the Salvation Army, traded in my Beamer on a red metalflake Caddy hearse with

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her name lettered on the side, and maxxed out my Visa and American Express on new clothes and equipment for her."

Braddock leaned forward, elbows on the desk. "That's a wonderful story, Cass. I'm really glad you shared it with me. But what is it you're trying to lead up to?"

This guy's one hell of a lot sharper than he looks or acts, Cass thought, pleased by his directness. She sat up straight and looked him in the eye.

"The night I burned my old life I made a vow to do everything I could to help Taz make her music. No conditions. No excuses." Her smile was gone now. "I intend to keep doing that."

"She can still compose and play," he said gently, "But there's just no way she'll ever sing again."

Cass shook her head. "That's unacceptable. To her, and to me."

The chubby surgeon sighed and refilled their cups. "I think I understand how you feel, but it simply isn't possible. She no longer has the necessary equipment. Her vocal cords are gone, and there's no such thing as a practical artificial substitute."

"Not as such," Cass agreed. She made a face, too tired to dance around the matter any longer. "Hell. Look Sid, let me lay out what I have in mind and you tell me what you think."

He spread his hands. "Tell away."

"First, I want to get her out of here before the media and her fans trash the place."

"Security has had its hands full," he admitted. "Though those people you called in have been a lot of help."

"I want to take her out of here by helicopter tomorrow, put her on a private jet and take her to Nevada."

"Tomorrow is too soon." There wasn't a hint of uncertainty in his voice. "Far too soon."

Cass waved his objection aside. "Then as soon as it is safely possible." She pulled out a fresh cigarette and fired it up, waiting to see if he asked the obvious question. He did.

"Why Nevada?"

She blew out a cloud of smoke. "That's where the Skyler Institute is."

Braddock grimaced at the name. Cass had been more or less expecting this reaction. "You've heard of the place, then?"

"I have," he began cautiously.

Cass held up her hand. "Look, I know Skyler's rep. He's a gelt and glory hound. He tries to bill himself as the 'Edison of Physiological Re-empowerment'—there's a term to make you want to puke—but what he's really after is big bucks and fame. The guy's a greedy asshole out to get rich off the handicapped. His ethics suck, no doubt about it. Some of the demonstrations of work done there have been in piss-poor taste. Any prosthetic devices or approaches that come out of the place have his name plastered all over them and are licensed to the highest bidder. But—" she held up a finger to forestall argument, "—some of the best people in the field are working for him. He rips them off, but he also bankrolls them to try things few other places would. I know one of the people who works there, a friend of mine from college.

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Dr. Woodrow Entwhistle."

"I've heard of him," Braddock put in. "Using computers to help people regain the power of speech. He helped develop the talkboard."

"That's him. If anybody can help Taz sing again, it's Woody."

Cass watched Sid nod and consider his words carefully before speaking. "I can understand your determination to help your friend any way you can, Cass. Although I have some, ah, reservations about implanting chips and electrodes in people, I admit that there aren't many other options available. But as I understand it, getting into one of Skyler's programs is quite difficult. What makes you think you even can?"

"Sid," Cass said with a throaty chuckle, "That was the *easy* part. Taz is famous and there's no way Skyler could pass up a chance to suck up some publicity. But I wanted this to be low profile, so I had to use another lever. I called Woody. He'd already heard about what happened to Taz, I guess everyone has. When I asked him if he could help her, he explained how he could probably make it so she can talk again."

"There's a big difference between talking and singing," Braddock pointed out gently.

Cass nodded. "That's what Woody said. But while he was explaining what it is he does, I got this weird flash that there *was* a way. It's gone now, but I figure I've got the time it takes to get her talking again to figure it out. Anyway, I told Woody I wanted him to work with Taz. When he started to hem and haw I told him to go see Skyler, tell him what I want, and explain that I'd settle two million bucks on his pointy head the day Taz was admitted with no publicity, and a few other conditions I laid out in a fax."

Cass could see that Braddock was impressed. She waved a hand dismissively. "I know that sounds like a lot of money, but I'm prepared to pony up every nickel Taz and I have between us if that's what it takes." In one way they were already halfway there, but that was nobody's business but her own.

Braddock shook his head, gazing at Cass in open admiration. "You misunderstand me. It's not the money that impresses me—though you did use a pretty big stick to get Skyler's attention. It's *you*. You really do refuse to accept what's happened, and you're prepared to move Heaven and Earth if that's what it takes to change it."

"Goddamn right I am." She gave him a warning look. "And I'll ride roughshod over anyone dumb enough to get in my way."

Braddock held up his hands palms out in a placating gesture. "Don't worry, as long as you don't try to move her too soon you'll have my full cooperation." He dropped his hands. "So tell me, did your friend take your proposal to Skyler?"

"He sure did."

"What happened?"

"Skyler called me back less than an hour later. All I have to do is make one call and he'll have his private jet on its way here to get us."

"You're betting everything on this working, aren't you?"

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Cass shrugged. "Hey, it's the only game in town."

"What happens if you lose?"

"I don't intend to."

"Is Ms. Baldwin aware of your plans for her?"

"Not yet."

"What if she won't go?"

Cass smiled. "Oh, she'll go. Even if I have to hog-tie her, stuff her in a canvas sack, and carry her there over my shoulder."

"Have you ever, um, dated a doctor?"

"No, I—" Cass caught herself, stared at him. "What?"

Braddock lowered his eyes, chubby cheeks coloring. "I have this, um, thing about, ah, Junoesque women who aren't afraid to, well, say and try to get what they want," he stammered.

Cass heaved her Junoesque—now wasn't that a way cool word?—body out of her chair, eyeing Braddock with amusement. And a bit of speculation. What he lacked in size he made up for in cute. And a doctor. God knows her mother would have approved.

"Tell you what, Doc. After all of this is over we could give it a try if you're still interested." She tossed off the dregs in her cup and ground out her cigarette. "But let me warn you, I'm nearly twice your size and I've got enough of that attitude for any four normal women."

Braddock stood up and shyly offered his hand. When she took it he met her gaze, an interesting gleam in his eye.

"All the more reason," he said.

* * *

Topaz had been just lying there on her bed and staring at nothing—contemplating her future—when Cass came in. The big woman dropped into the chair beside the bed.

One look and she knew that Cass still hadn't slept yet. She looked dead on her feet, her eyes sunken and her normally ruddy complexion almost gray with fatigue.

Sighing because she hated the thing, Topaz dragged the talkboard off the bedside table and onto her lap. The device had been built to endure frustration, and had survived its crash landing intact.

She switched the board over to sentence mode. It didn't take long to type in what she wanted to say. A double click of the SPEAK button completed the sentence.

"Go to b-ed C-ass."

Cass gave her a tired smile. "Soon, Taz. There's just one last thing I have to do first."

Topaz arched an eyebrow in question. *What?*

"Talk to you, darlin'. Talk about what we're going to do next."

She stared at Cass, caught between anger and pity. Didn't she get it? *Nothing* happened next. No more albums. No more concerts. No more videos. No more interviews where some maniac could—

"Do you trust me, Taz?"

The question caught her off guard. After a moment she nodded. Of course she did.

"You depend on me to keep the roads open for you, and so far I've

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done a pretty good job, haven't I?"

Another cautious nod. Not that she disagreed with anything Cass had said, it was just that she was obviously leading up to something, and from the sound it wasn't going to be good.

Cass leaned closer, her mouth twisting like she was tasting something bitter. Topaz smelled whiskey and cigarettes.

"What's happened to you is killing me, Taz," she rasped. "I can't let it end like this. I can't—" She shook her head. "I can't endure the silence. So I've gone ahead and made a deal to take you someplace where maybe they can do something about it."

Topaz scowled and hammered out a reply on the talkboard.

"Noth-ing can be done ab-out it."

Cass sat back, a grim smile appearing on her face. "Listen, honey, you said nothing could be done when your old label tried to screw you out of your third album."

She thumped her chest. "I made the bastards sorry they even tried. When that slimeball photographer hired to do the photos for your fourth album tried to sell those T&A shots he'd snuck of you changing clothes, you said nothing could be done. Those pictures got buried and buried deep. You said nothing could be done when MTV said your "Cold Hard Hand of Rape" video was too controversial to run. They gave you an award for it six months later. Your job is to make your music. My job is to make sure *nothing* gets in your way."

Her heavy brows drew down. "Some asshole tried to take your music away. I don't intend to let that happen. Do you?"

Topaz stared back at her old friend. That last had been spoken like a demand, but there was no mistaking the undertone of appeal in her voice and behind her eyes.

Still, what could she say? There was no *let* to it. When someone kills you, it's not a matter of letting yourself be dead. Singing was the mainspring which drove her music. The man with the bat had destroyed that and now her time was over.

Cass took her hand. "Don't you want to be able to talk again?"

A shrug. When your life is over you don't really have much to say, do you?

Cass' grip tightened. "Don't—" She grimaced. Her voice dropped to a gruff whisper. "Don't you want to be able to sing again?"

YES! If she could have screamed it aloud she would have been heard from one end of the hospital to the other. There could be only one answer to that question. There was a raw hole torn in her soul where singing had been, and it felt like everything else of any value inside her was bleeding away through it.

Cass's grip was inescapable, almost painful. "Is making your music really more important than anything else," she went on harshly, "Or have you just been bullshitting me since day one?" Her gaze bored into Topaz's eyes, making her squirm. "We made a pact back then, you and me. Are you going to break it now? Or are you going to trust me and work with me and try to *beat* this?"

Topaz looked down, absolutely lost

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in a tangle of contradicting thoughts and emotions. Anger. Resignation. Despair. Resentment. Desperation. Spread over them all like a suffocating blanket of darkness was this ever-growing, numbing apathy. She couldn't find it in herself to believe that the silence could be broken. Hope was beyond her.

Contemplating the blank tape her life had become spooling on out ahead, she saw that it really didn't matter what she did next. The bandwagon had hit a brick wall and not even a master fixer like Cass could patch it up and put it back on the road again.

She looked up at Cass. How badly she wanted this was written in every line of her face. It took her back to when Cass had first appeared at the foot of the stage and nervously asked if she needed or wanted a manager.

For ten years now Cass had asked for little and never refused her anything that really mattered. Had never failed her.

She gave a resigned nod. If nothing else, she could oblige for old times' sake. Besides, Cass would just keep hassling her until she gave in, and all she really wanted was to be left alone. Give in. Go through the motions. She didn't have the energy to fight.

Cass closed her eyes, and for just a second Topaz thought the big woman was going to cry. For all the time they had been together she had never once seen Cass cry. Not over men, not over the loss of friends to AIDS and age and accident and a lifestyle that treated people like crash test dummies.

After a few seconds Cass opened her eyes again, producing something like a smile. "Thanks, Taz," she said gruffly, giving her hand one last squeeze before standing. "You get some rest now. I'll see you in the morning. If you want me, the hospital switchboard will put you through to my phone. I've reserved a room at the Ramada right across the street."

Topaz watched her leave, walking very slowly and carefully, as if there were some great weight balanced on her broad shoulders. When the door closed behind her she turned her eyes toward the ceiling, sinking back into the black muck of despair.

Cass lowered herself into the tub of scalding hot water cautiously, hoping it would leach enough tension out of her body to let her sleep. Once she was sitting down she took a less than dainty sip of the straight bourbon in one hand, then settled back with a groan.

"Cassandra Morgenstern," she said, her voice sounding hollow and portentous in the tiled bathroom. "Big bad hard-ass Cass."

Another sip. She closed her eyes.

"What the hell have you done?"

Ah, but she knew exactly what she had done. Bulldozed Taz into going along with her hare-brained scheme by promising the impossible, even knowing what failure could cost.

She drained the glass and put it aside.

Then there in the safety of a locked bathroom in a locked hotel room, she finally gave in to doubt.

She finally gave in to tears.

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* * *

The huge, rambling, red-tile roofed Spanish style structure which housed the Skyler Institute was located in north central Nevada, about twenty miles west of Winnemucca near the Little Humboldt River. It had been built in the thirties as a very private, very exclusive, very expensive sanitarium. In the late fifties it had been converted to a fat farm and spa for the same class of clientele.

In the early eighties it had been turned into a place for high rollers to get a handle on their coke habits. Unfortunately this clientele's bill-paying habits turned out to be as erratic as their commitment to a drug-free lifestyle. Henry Skyler, who had gotten his start not in science or medicine but real estate, had snapped the place up for next to nothing from its all but bankrupt former owners.

Exactly one week to the day after she had been attacked, Topaz and Cass were escorted into the sunny second-floor suite of rooms where they would be staying by one of Skyler's aides. Their suite was one of a dozen he kept for important clients and prospective investors.

Cass shooed the woman off, then wheeled Topaz into the center of the sitting room. Open and airy, it had been decorated in a southwestern motif. "Well, that was one hell of a ride," she said, beginning to prowl the room. "Sure glad it's over."

Topaz had to agree. Her face was pale and drained, her eyes smudged with exhaustion. She hadn't been particularly happy about Dr. Braddock's insistence that she use a wheelchair for the trip. But after boarding a helicopter on the hospital's rooftop helipad, riding in it out to New Jersey, transferring to a waiting Lear Jet, crossing the country, then boarding another 'copter for the ride out here to the middle of nowhere, she was glad she had it.

The talkboard was clipped to one arm of the wheelchair. She tapped out a reply. "St-ar tr-eat-ment. I-m sur-prised Sky-ler did-n't meet us him-self."

Cass snorted, looking up from her inspection of the videophone. "He's probably sulking. I told him one peep of publicity and I'd knock half a mil off his 'contribution,' and that if he kept out of our faces I'd sweeten the pot by the same amount. I imagine he's holed up in his office right now counting his money and chewing on his own liver."

Topaz tapped out a question which had been on her mind. "D-id I re-ally have two mil-lion dol-lars, C-ass?" It hardly seemed possible. She knew she made money, but that much? Cass gave her financial statements quarterly, but to be honest she had never looked at them. If she wanted something expensive she asked Cass, who then bought it for her if she could afford it.

Cass didn't answer immediately. She headed over to the small wet-bar set up just beyond the heavy, dark wood, ersatz-rustic table and chair set. Ducking down, she peered into the small built-in fridge.

"All right, they got one thing right," she said, pulling out a beer and a Diet Pepsi. She searched the bar with a frown. "No straws," she muttered

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darkly, reaching inside the pocket of her black denim jacket and getting one. The straw went into the soda, which she brought to Topaz, who took it gratefully.

The big brace was off her neck now, but it was still stiff and sore. Straws made drinking easier. One small square bandage covered the healing hole at the base of her throat. The surgery itself had been done by going down her throat through her mouth, and using a lot of scary sounding instruments whose names began with *tracheo-* or *laryngeo-*.

Cass twisted the top off her beer, took a swig. "You've got quite a bit more than two mil stashed away," she said at last. "Don't go worrying about what this is costing. OK?"

"Is in-sur-ance cov-er-ing it?"

"It's covered. Leave it at that."

Taz shook her head. "I w-ant to kn-ow." Cass was hiding something, and she wanted to find out what it was.

Cass sighed. "I'm picking up the tab, OK?"

"You had th-at much mon-ey?"

Cass only shrugged. Topaz started to get angry. "W-ell?"

"I had about a million three I could lay hands on fast." Cass answered in a flat, inflectionless voice. "OK?"

Money—especially large sums of it—had never been particularly real to Topaz. Still, she could add. "Where did the r-est come fr-om?"

Cass frowned at her beer bottle. "If you must know, Gabe Wickenstahl of Plutonium Cream Pie has been after me to sell him my place ever since he came to that party I threw last year. I gave him a call."

Topaz stared at her. She started to speak, caught herself, typed it out instead. "You s-old your hou-se? Why?"

"Hey, it's an investment, OK?" Cass answered gruffly. "What the hell good are you to me like this?"

Topaz knew she was joking. Any other time she might have laughed, but at that moment it hit hard enough to bruise bone. It had a cruel ring of truth to it. It gave a shape to the diffused resentment she'd been feeling about being made to come here when all she really wanted to do was crawl into a hole and die.

An uneasy silence reigned until she broke it by saying, "I-m ti-red," through the talkboard.

"Jesus, you must be," Cass said, looking relieved. She put her beer aside and pushed her into one of the suite's two bedrooms. Topaz let herself be helped out of the chair and into the bed, biting her lip and resenting being treated like a child or a cripple.

Cass closed the drapes to shut out the late afternoon sun. "You rest here a while, love. If you want anything, I'll just be in the next room." She reached into the side-pocket of her jacket and pulled out a chrome-plated whistle. "Just give this a toot and I'll come running."

Topaz nodded. Cass put the whistle on the bedside table, then went back into the other room, leaving the door open a crack behind her.

Topaz stared at the door, her lips pressed together in dull-edged anger.

What the hell good are you to me like this?

That's how it felt. Since the attack

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walls had come up between them. There was still a door, but it was closing more every day. Well, a lot of doors had closed since then. . . .

Her eyes dropped shut. So tired. Her thoughts slumping into a muddy jumble. She tried to pry them open again, not wanting to let herself fall asleep.

That was where the man with the bat waited for her.

Cass hooked another beer, then parked herself at the videophone. She found the inhouse number she wanted in her notebook and punched it in. ONE MOMENT PLEASE appeared on the paperback-sized screen. Bad tinkly Muzak cut in.

She tipped her head back and took a long swallow of beer. The Muzak stopped. When she lowered the bottle and looked at the screen again Woody Entwhistle was grinning up at her on it.

"Casster! You made it!"

She smiled back at him. "The big-assed bird has landed." Although they had kept in touch by the odd midnight phone call, it had to be at least six years since she had last seen him. He appeared to have changed little from when she had met him at USC. A little less hair, but not much. "You look good, Woods."

He leered at her. "So do you, babe."

She snorted. "Yeah, right. I've dropped ten pounds in the last week, and it all seems to have come from the only place I can't afford to lose it—namely my tits." She shrugged. "Look, we can get together and compare middle age later. Are you ready to start working with Taz?"

Woody's smile softened. "Same old Cass. All business." He shook his head. "I remember the first time you saw a surfboard. You asked me which made the most money, renting or selling them."

"That's me," Cass agreed glumly. "The soul of a cash register."

"Cass," Woody said gently, "I'm not kicking sand. I know this is really mega-important to you. You've put yourself out on a limb with this."

"I hope you're not afraid of heights, Woody, because I've brought you out here with me. I told Taz we'll be able to help her sing again."

He winced. "Yow."

She nodded. "You're telling me."

He raked his fingers through his hair, looking decidedly unhappy. "I thought you understood that I can't do that. Talk, yes. Sing? No can do. We're just not there yet. We're not even close."

"I know. Believe me, I know. But it was the only way I could get her to come. And the thing is, that first time I called something you said rang a bell. It was just a flash, and it's gone now. Hell, it was in and out of my head so fast I sometimes wonder if it was even there." She took a deep breath. "But I'm willing to bet there is a way, and we can find it."

"So you shelled out two million bucks to bring her here and promised she could sing again all on a *hunch?*"

She met his gaze squarely. "Yes."

He chuckled, shaking his head in amazement. "You got balls you could like bowl with, lady. That's one hell of a gamble."

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"More than you know." Never once in the time she'd known Taz had she ever promised something she couldn't deliver. This would be the worst possible time to let her down. Failure would equal a betrayal of trust. It would be devastating, plating her despair in iron.

"Your idea's still hiding?" Woody asked.

Cass rubbed her tired eyes. She had a splitting headache, jet lag, and she felt old. Forty going on four hundred. "You could park cars in my brain."

"Bummer. So the plan is to start with what we can do and hope you catch a wave for the rest, right?"

"That's it."

"Does she know what it is we'll be doing?"

"She hasn't asked. I don't think she cares."

"Do you think she'll be cooperative?"

Cass glanced towards Topaz's bedroom. "I doubt it. She's down. Real down. Figures she's already beaten."

"Do you know what you're doing, Cass?"

Cass drained her beer before answering. "I'm beginning to wonder."

The next morning Topaz found breakfast waiting for her, and Cass gone. A note propped against the coffee butler only said that she would catch up with her later on.

A chesty redhead in a pink blouse and slacks turned up a few minutes later, saying she was supposed to take her to the Speech Lab. Her name tag read *Candy*. The name fit.

Obviously awed by meeting the actual Topaz Baldwin, she more begged than insisted that Topaz ride in the wheelchair. Once they were out the door and in the red-tiled hallways she launched into a disjointed, gum-cracking explanation of what went on in the various parts of the Institute and which of the male staff and patients were like total steaks and which were like weenies.

Topaz let herself be pushed along, Candy's babble going in one ear and out the other. The talkboard was clipped to the arm of her chair, but it was too much trouble to tell her to shut up. Her journey ended at the north wing of the first floor, in front of a set of wide double doors. A plate by the doorframe read SPEECH LAB *Dr. Woodrow Entwhistle/Dr. Sarah Bright*.

"Woody's like a total berg," Candy confided conspiratorially before opening one of the doors and wheeling her inside. "Ms. Baldwin is here," she called cheerily as they entered. "Are you here, Dr. E?"

The speech lab turned out to be a large, high-ceilinged room illuminated by the morning sun pouring in tinted floor to ceiling windows. Spread through the left side of the room were randomly placed and sized low-walled work areas filled with computers and other electronic equipment. Perhaps a dozen casually dressed people were at work in them.

On the right was a larger workspace with as many plants as machines. The woman working inside looked up and smiled. Nearby was what looked like some sort of soundproof booth, and a long low work-

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bench covered with tools and complicated looking test equipment.

"Yo!" There was a long low worktable straight ahead. A man's head appeared to one side of an oversized computer monitor. "Over here!" He disappeared as Candy wheeled her closer. A half-dozen computers and other pieces of unidentifiable equipment covered the table, a thicket of cables hanging to the floor. There were wooden tubs at either end of the table, each one home to a potted palm whose green umbrella top was a good eight feet above the floor. Standing guard by the base of each palm was a pink plastic flamingo.

The man appeared again, "Thanks, Can-dee. I'll take it from here."

Topaz heard the aide giggle and walk away. She sat there staring at the man behind the table, wondering if he could possible be Dr. Entwhistle. The title *Doctor* and the fact that he ran one part of a research facility had given her certain expectations of what he would look like. They were not being met.

"Give me one more sec here," he said, flashing her a toothy, hundred-kilowatt grin before looking down and tapping something into an unseen keyboard. "There. The Mario Brothers are on their own for a while."

She was momentarily confused when he started coming around the table without standing up first, but when he rounded the corner she saw that he too was in a wheelchair.

From the waist up he was an album-cover perfect California surf-bum; tanned, muscular arms and chest, faded Vuarnet tank-top, square-jawed face with blue eyes and perfect white teeth framed by a shoulder-length mane of slightly receding, sun-bleached blond hair. It seemed impossible that anyone named Dr. Entwhistle would wear a gold earring. He had four in his left ear.

A wide waist-strap held him in his chair. His ragged cut-offs suited him, but the body below the strap seemed to belong to a whole other person. His legs were tanned, but both were badly twisted and scarred. One was at least six inches shorter than the other.

He rolled to a stop and held out his hand. "Hi! I'm Woody Entwhistle. And you are the one and only Topaz Baldwin." He chuckled. "You probably already knew that."

Topaz nodded uncertainly, keeping her hands on her lap.

He turned the attempted handshake into a broad inclusive wave of his hand. "We're all pretty pumped about having you here." He laughed and shook his head. "Let me tell you, the Cass-Lass really turned this place on its ear. When I hit the Hankster with her deal he nearly flipped out. Two million bucks and a chance to get his hooks on the one and only Topaz Baldwin? Man, he thought he'd died and gone to Fort Knox. Then he found out he couldn't suck any publicity out of it. . . ." An amused shake of the head. "Dude turned three shades of purple and just about swallowed his tongue."

Not knowing what else to do, she shrugged.

"Right, right. You don't know the

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Hankmeister well enough to know why that's funny. But trust me, it is."

Topaz looked around the room again, then bent over her talkboard and typed out a question. "Wh-at are you go-ing to do to me?"

He crossed his muscular arms, beaming at her. "Try to fix it so you can talk without your fingers having to walk."

She picked out another question, not hitting the SPEAK button until she was looking him in the eye. "W-ill I ev-er s-ing a-gain?"

His smile faltered. "I can't promise that."

"C-ass says I'm go-ing to."

"Cass is one determined lady," he said carefully. "What do you think?"

Topaz sighed. She hammered out her answer, striking the keys vengefully. "No. Nev-er." The robotic voice gave her words an air of cold finality.

"I see." He cocked his head. "What about talking? Wouldn't you like to be able to do that again?"

"It does-n't mat-ter."

Woody appeared to ponder her answer for several seconds. At last he asked, "Then why did you come here?"

"C-ass."

"You two are pretty tight, huh?"

"We were."

"Were as in not any more?"

She shrugged. It wasn't anything she wanted to talk about. Besides, wasn't it obvious?

"Why not?"

Her face tight with anger she pounded out an answer. He wanted to know? Then she'd tell him. "I was a sing-er. She was my man-a-ger. I-m no fuck-ing good to her like th-is." She stared at him defiantly, daring him to argue.

"Man," he said softly, "That really sucks." He shook his head. "Well, long as you're here let's see what we can do. The ticket's bought, might as well take the ride." He rolled his chair back and away, then bellowed, *"Sarah!"*

The woman who answered his call came out of the large workspace on her right. Tall, maybe in her late thirties, she had a model's cheekbones and straight salt and pepper hair that hung almost to the waist of her faded jeans. She sauntered over to his side. He slipped a tanned arm around her. "This is my main squeeze, Dr. Sarah Bright. Sarah, this is Topaz Baldwin."

The woman had a warm, kind smile. "Pleased to meet you, Topaz," she said. "I'm also the surf-bozo's chief collaborator and second in command."

Woody rolled his eyes. "This soon to be demoted person will explain the program to you and help you get started. OK?"

Topaz shrugged. She was beginning to realize that as long as she could do that, she was able to say what she wanted to say most of the time anyway.

Sarah detached herself from Woody, came around behind Topaz and began pushing her toward the large workspace on the right.

His smile fading, Woody propelled his wheelchair around behind the isolation booth, past the workbench and toward a door marked PRIVATE.

* * *

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Cass tried to have a smile ready when Woody joined her in the observation room. None came. She turned back toward the video monitor which showed Sarah ushering Taz into her plant-filled workspace. The high camera angle and black and white picture made it look like a scene from an old *film noir*. Not a happy ending sort of flick.

"You OK, babe?" Woody asked as he maneuvered his wheelchair around behind the console beside her.

"Just ducky." That was one of the advantages of having a froggy voice like hers. It always sounded hoarse.

Woody parked his chair beside her and covered one of her hands with his own. "I don't think she really meant what she said."

"I know."

"Still it had to hurt like a bastard."

"She's really hurting. I'm her manager. I've got to get my percentage." She took a deep breath, shaking off his hand and swiveling here chair to face him. "OK, enough soap opera. Let's get down to business."

He shook his head. "You're really something, Cass."

"Yeah, but what?"

"Something exceptional. You really love her, don't you?"

Cass gazed at the small, unhappy woman in the wheelchair listening as Sarah began explaining what they would be doing. A big shimmering bubble of emotion swelled up inside her, making her feel helpless and lost. "Until I met her I didn't even know how to love myself," she murmured. "That's getting a lot harder to do lately."

The list just kept getting longer and longer. Promises she shouldn't have made. Bad jokes that came back sounding cruel and insensitive. Being here, hidden away, ready to lend her expertise in manipulating Taz if it was needed.

Woody patted her arm. "I think it's worth the effort."

"It's a dirty job, but I suppose somebody's gotta do it," she said, summoning up that glum wisecrack to help shake off the mood that had fallen over her. She slapped her pockets in search of her cigarettes. Lighting one, she drew the smoke into her lungs like it was a source of strength. Woody looked disapproving but held his tongue.

"OK, whiz-kid," she rasped through a wreath of smoke, "Walk me through the whole program. Maybe it'll shake something loose."

"One shaking coming up," he said as he turned his chair to pour two cups of coffee from the pot set up within easy reach of the line of monitors. He handed hers over, along with a saucer to use as an ashtray. "Which version do you want? Pure jargon, or the chopped and channelled gonzo version?"

"Better make it gonzo, but don't skimp on details. I didn't quite get all of it on the phone."

"An excellent choice, modom." He took a sip of his coffee. "Here we go. Speech is a mucho complicated process. Sarah and my work is with *articulation*, the physiological end of speech. Putting aside the way hard question of how words and phrases

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are mentally processed—and we might as well 'cause we really don't know do-wah diddley about it—we're still left with a whole lot of different processes working together all at once. Pick a word, any word."

Cass swallowed a mouthful of coffee. "Uh, word."

"Smartass. OK class, let's produce the word *word.* Act one: a column of air is pushed up through the windpipe and into the voicebox. There it's forced through the vocal cords to make a sound. Now these guys are very thin and elastic, and when air is forced through them they vibrate—"

"Like making a Junior Mints box hum."

Woody laughed. "Right. Only they can be controlled to raise or lower the frequency by changing the size of the opening and the amount of tension on them."

Cass nodded. "That's where Taz's problem is. Her voicebox was crushed. Sid Braddock was able to, um, uncrush it, but to do so he had to remove her vocal cords and take away the strain they put on it."

"You got it. She's like a wind instrument that's lost its reed. Now there's more to this part, like the larynx moving up and down to change the size of the resonating chamber of the pharynx and further altering the tone, but we'll move on now to the really tricky part. That happens in the mouth.

"For speech to be more than hums and grunts it has to be shaped. To do that we use the mouth—lips, teeth, palate, even our old friend the glottis. But this part of the speaking process is a lot like French-kissing. The tongue's what makes it happen. Now what was our word, class?"

"Word."

"Say it verrrrry slowly, and pay close attention to what goes on as you do."

Cass did as he said. The *w* sound had her pursing and then opening her lips, the sound buzzing over top of her tongue. The *or* sound hauled her tongue back and down, only to have it head for the roof of her mouth and hit the part of her palate just over her front teeth as it started the *d,* flipping back and her mouth opening as she finished it.

"Neat, huh?" Woody asked with a grin. "Every time you say a word there's a three ring circus in your mouth. Topaz is an ideal candidate for our approach because all her upper equipment is intact. For us the deal-breaker is the tongue. In some ways that's the master organ of speech."

"Taz just can't make any sound to shape."

"Right. Now there has been some work done on artificial vocal cords, but so far they only make people sound like they've swallowed kazoos. Our approach is to use a computer to produce the sound. Here's how we do it."

Cass butted out her cigarette and lit a fresh one, listening intently to every word he said. It was somewhere in here that the idea had flitted through her mind.

"Speech can be broken down into separate sounds called *phonemes.* Each phoneme is created by a certain discrete set of physiological actions.

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What we do is monitor these actions and identify them."

"Yeah," she put in. "This is one of the parts I didn't get straight. You said *something about wiring her teeth?*" She'd imagined Taz having to wear something like braces.

"We sure do, but we don't use wires. Tiny—and I mean *tiny* transmitting transducers will be bonded either to or between her teeth. All but two go inside, and they're all coated with white enamel so they hardly show. These will tell the computer what she's doing with her mouth by giving it a relational geometry. It will know if her mouth is open or closed, and the relative position of her teeth, lips, and tongue.

He lifted his chin and ran a thumb and finger down the front of his neck. "Electrodes along here will read the messages going to her voicebox and its relative position. We start out with big ugly surface 'trodes, but later on ones just a little bigger than BB's can be implanted beneath the skin. One other pickup that works more like a microphone tells the computer how much air is being pushed up the windpipe. That provides a volume reading. With me so far?"

Cass put down her empty coffee cup. "I think so. The computer uses all this information to decide exactly what kind of sound the person is trying to make."

"You got it. Each particular configuration triggers the computer to make a certain sound."

"Kind of like a MIDI and a sequencer setup in music?"

"A lot like. You could even think of each particular configuration as a chord to be played."

"So she'll be able to talk as soon as you wire her up?"

"Yes and no. Sarah has developed rough paradigms for the phonemes—that's her specialty—but the results are pretty crude. For one thing, they have too much chop and mush."

Cass chuckled. "Sounds like a British breakfast."

"Right, just add tea and boil. The thing is, sounds flow into each other, they're not just a hopscotch from one to the next—except when they are. Chop is what you get when the various phonemes are too discrete and badly matched, the computer voice effect. Mush is just the opposite, the stringing together of that which should hang loose."

Cass asked the obvious question. "So how do you get around it?"

Woody spread his hands. "By one hell of a lot of very boring work tailoring the paradigms. You see, what we're trying to provide is natural sounding speech. The voice is synthesized, but anything we can do to humanize and personalize it is worth the effort. So we'll sit her down and find out *exactly* how she used to speak. First we run through the single phonemes, altering the sound produced until we're all satisfied with it, and having her repeat it a pain in the assedly monotonous number of times. That gives the computer a broad sample of how she makes that sound. Once we've covered the single phonemes we move on to pairs, then triplets, at last concentrating on

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about a thousand words that have been carefully chosen to cover a broad spectrum of convoluted but typical phoneme combinations."

Cass crushed out her smoke. "It learns the difference between *word* and *want* and *wash* and *well.*"

"Very good, class. One bonus to this approach is that it allows the computer to learn the stresses and slurs that make up a person's individual speech patterns and accent."

"So Taz will have to lug a computer around with her for the rest of her life?"

Woody grinned at her. "There are computers, and then there are computers, my sweet. The initial articulation recognition paradigms are worked up on a monster desktop. The software alone runs to a hair over thirteen megabytes. But the trigger values themselves are quite compact. The phoneme paradigms are encoded on a chip about the size of a postage stamp. That chip controls a voice synthesizing sound chip about the same size."

He reached into a leather bag hanging off one arm of his wheelchair, held out his closed fist. "Here, check it out."

Cass held out her hand.

He dropped a necklace onto her palm. Hung from a gold chain with a clasp on the back was what looked like a two inch square of polished onyx surrounded by woven silver filigree. The pendant was slightly thicker than her little finger. She turned it over. Its back was stainless steel, like a watch. She glanced at Woody, puzzled. "What's this?"

"Topaz's voice."

She frowned. "You're shitting me."

"Nope." He pointed. "That black surface in front is a laminar surface transducer—essentially a speaker. The fancywork around the case is the antenna which picks up the signals from the bugs in her mouth and neck. The back pops off like a watchcase. Inside it are a receiver chip, the voice paradigm chip, the sound chip, and a rechargable battery."

Cass let the device dangle from one finger, glittering in the bluish light from the monitors. "This is amazing, Woody!"

He polished his knuckles on his chest. "We kind of think so. That's the state of the art you're holding there. In another couple months the Hankster is going to put this puppy up for grabs, along with the software to train it." His grin widened. "You picked a good time to call 'cause he's pretty high on me and my posse right now."

"I imagine he would be." She handed the device back over. "It's perfect."

He shook his shaggy head. "Nah, not even close. It costs a bundle to hand make each one. Mass production will cut the cost, but it's still going to take a highly trained operator and some fairly heavy-duty computer equipment at least two weeks to impress each one. The battery has to be recharged after about sixteen hours of use, but it just sits on a little charger stand and comes back up in about three hours. The voice is sex specific and pretty good, but it's still obviously synthetic. The size of the output device limits sound quality as

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well. The generation before this had slightly better reproduction, but the speaker was twice as big and looked just like one."

He slipped it back into his side bag. "We're working on the next generation, but it's far from ready. You could think of this as one of those little el cheapo electronic keyboards. It's small and self-contained and makes pretty good sound for its size, but it ain't no grand piano."

"And for Taz to be able to sing you'd need a grand piano."

"At least." He toyed with one earring. "So, any brain action?"

"Not really." She glanced at her watch, grimaced. "Hell. I have to go make some calls. You guys can handle Taz for a while?"

"We'll yell for help if she starts wrecking the place."

Cass stood up, taking one last look at the monitor. Taz sat there listening to Sarah, her arms crossed before her chest and an unhappy frown on her face. "Be patient with her," she said softly.

"We will." He squeezed her hand as she edged around his wheelchair. "Hang in there."

"If my fingernails give out there's always my neck." She slipped out the observation room's side door and into the sunlit, empty corridor. She hesitated, brow furrowing in thought. Something Woody said. . . .

"Lost?"

Cass blinked in surprise. The question had come from a short Hispanic man with a truly splendid bandito mustache. *Dr. Ricardo Perez,* read his nametag. The amused look on his face hinted that he'd been standing there watching her spacewalk for more than just a couple seconds.

She shook her head. "No more than normal."

"Man, I know how that feels," he said with a laugh, and went on his way.

Cass watched him walk away, rubbing her mouth thoughtfully.

"Grand piano. . . ." she said in a soft, bemused voice.

Topaz let the aide wheel her back into the living room of their suite, then dismissed him with a curt wave of her hand. As the door closed she got out of the chair and headed for her room. Her legs felt stiff, but that was mostly due from sitting all day.

Cass was on the couch, hunched over her laptop. It was set up on the coffee table and surrounded by papers, empty beer bottles, and an overflowing ashtray. She looked up and smiled. "How'd it go, Taz?"

Topaz opened her mouth to say something, then closed it and shook her head. She turned her back on Cass and walked stiffly to her room. Just so Cass would have no doubt about how it went she slammed the door behind her.

"That good, huh?" Cass said with weary irony, lighting a fresh cigarette and going back to work.

Topaz sat on the side of her bed, back stiff and tightly strung as a guitar neck, her hands clenched into fists. It was all she could do to keep them from starting to beat on something. On the walls, on herself.

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So this was Cass' big plan. Letting them glue crap inside her mouth and stick stuff to her neck so she could end up sounding like some movie android.

Her gaze swung toward the bedroom door. There she sits, shuffling papers like nothing had happened or changed. Expecting me to be grateful for *this?*

Ever since the attack her feelings toward Cass had changed faster than the picture on a video surfer's TV screen. Love/hate/gratitude/resentment/concern/contempt/suspicion. . . .

She owed Cass her life—for whatever that was worth. She'd tackled the crazoid who attacked her and kept him from finishing what he had begun, then pinned her to the sidewalk, whispered *this is gonna hurt, honey,* and cut the hole in her throat, which had let breath back into her spasming lungs. Saving her life twice in two minutes. Condemning her to live like this.

Cass spending her own money —even selling her own house—to get her here. Generosity . . . or protecting her investment?

Cass promising she would sing again.

There was the barbed wire binding the snarl of confusion. The poison in the well. The tangled root of her growing distrust.

She didn't believe it could happen. But god help her, she had *wanted* to believe it could. Cass had set one sharp hook of hope into her heart, only to have it be ripped out by inches.

Topaz slumped back on the bed, her head pounding. She just couldn't resolve the equation. *Cass had to be lying to her; Cass never lied to her.* Around and around it went, spinning like a lathe, cutting away certainty and trust.

She found herself remembering sitting on a hard pew, the air in the church cruelly sweet with flowers, mournful, syrupy hymns like some awful Muzak in her ears. There in front of her the two closed wooden caskets holding what was left of her mother and father. Literally ashes to ashes because the plane crash and fire had not left enough of them for her to be able to take a final look at their faces. Sitting there, a black dress filled with emptiness. Unable to think of them without the memory peeling another layer off her heart with the blunt razor of grief.

Cass beside her, holding her hand. Cass, who had handled all the arrangements and kept the microphones and cameras out of her face. Cass, who had been there when the terrible phone call had come, held her when she cried, and scarcely left her side all through it. Cass, the rock.

Cass, who had leaned over and whispered, *It'll get better, Taz. You'll be able to remember them and smile.*

Anger had sparked and died in her like a wet match. Cass had done so much that she had to be forgiven the glib platitude. It was just one more of the many she'd been forced to endure.

Yet within a few days Cass had been proved right. Oh, it still hurt, it hurt to remember even now, but their memory became something to

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cherish, not something to shut out because it made her wish she was dead herself.

She didn't know what was happening to her. Since the attack it seemed like her emotional range had been reduced to three grim notes; anger, apathy, and despair, and they played over and over like she was stuck in a single groove of an old LP. Everything else seemed beyond her. And as for Cass. . . .

Topaz closed her eyes and curled into a fetal ball on her bed. Her head hurt. Her throat hurt. She was so tired she couldn't think straight. If she let herself sleep then all the pressures inside her would let up for a while.

But it would be nothing like restful, for in her dreams a tall man in a long coat would scream at her and swing his bat, and with one stroke the nightmare would begin again.

Then she would awaken in a cold sweat, a silent scream trapped in her useless throat. If she was lucky.

Cass was slouched on the couch with her feet up on the table and a beer in her hand when Topaz came in at the end of the next day. She knew it had been a rough day for her. She'd watched part of it from the observation room.

In the morning various measurements had been made in Taz's mouth and a cast had been made of her teeth. Woody had used a computer to plot out the optimal placement for the transducers. In the afternoon she had submitted to having them bonded in place with the indifference of a car with its hood open. Cass had been forced—though actually it was a relief—to leave partway through the procedure to accept and oversee a delivery. After that he and Sarah had worked out the placement for the electrode array which would be gummed to her slim neck, marking each place with an X of seven-day ink.

Although still escorted by an aide, she had been allowed to walk to and from the speech lab. Cass had hoped that this small reclaimed freedom would help her be in a better mood.

So much for plan A, Cass thought glumly when she came in the door. *Let's hope plan B works better.* Topaz looked in a sour mood, her mouth a tight line and a warning crease between her brows. Underlying that was a pale, hollow-eyed exhaustion. She hadn't been eating. Cass was pretty sure she wasn't sleeping well either. But every time she brought the subject up all she got in return was a blank stare.

Cass waited for her to notice the new addition to the room, hoping it would break through the icy walls she'd thrown up around her. Something had to.

Topaz glanced incuriously in her direction, about to give her the grimace that passed for a greeting of late. Then suddenly she saw it. Her dark eyes went wide with surprise.

Cass watched Taz slowly approach the piano, doing her best to keep her face expressionless.

Getting it had been no easy feat. It had taken Cass half a dozen calls to track down a vacationing Ariana Christensen, the West Coast rep for Steinway. It had taken Ariana about

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that same amount of time to track down what Cass wanted. Then the two of them had embarked on a roving conference call, nailing down the logistics of getting the full concert grand piano delivered, set up and tuned to perfection in the middle of the Nevada desert within twenty-four hours.

It had cost a bundle, but if it brought Taz out of herself then the cost and effort meant nothing.

Taz ran her fingers along the instrument's glossy flank, her reflection chasing her along the grain. The look on her face said she was having a hard time believing it was real.

Cass knew that Taz thought white pianos belonged in cocktail bars, and had decided that a black piano might be too depressing. This beauty glowed with the rich dark red of lacquered rosewood. She'd had it set up near the sliding glass doors leading out onto the balcony so that Taz could sit at it and gaze out onto the austere beauty of the desert.

Topaz's trailing fingers led her around to the gleaming keyboard. Cass held her breath as Taz reached out hesitantly, one slim finger poised uncertainly over an ivory key.

When it fell a single note welled up, pure and sweet as water springing up in the middle of an arid wasteland. Something inside Cass dissolved and went *aaahhhh*.

A second later Taz's face contorted in sudden rage. She slammed the cover down over the keys hard enough to make the strings inside ring in discordant sympathy. Pausing only long enough to fire a look of blackest hatred at Cass, she stormed off to her room.

Cass let her breath out slowly.

"Any more bright ideas, girl genius?" she asked her beer bottle. Getting no answer, she drained it, then just sat there in the silence fighting the urge to hurl the empty bottle at the closed bedroom door.

See the pretty piano, Taz? Topaz mimicked Cass' raspy voice in her head. *Make some pretty music, girl. After all—*

She flung herself on the bed.

—you're no good to me like this. No good to anybody at all.

The pant and huff of her breath and the muffled thump of her hands pounding the pillows in frustration was the loudest sound she made.

Cass was not the sole focus of her rage. At least half of it was hatred for what she had become.

Cass hustled into the speech lab's observation room a bit before eleven that next morning, answering Woody's call.

"What's up?" she panted as she closed the door behind her. Running was not one of her A skills, and dangerous in the bargain. You could die from it.

"Nothin'," he drawled, eyes on one of the monitors.

"What the hell do you mean *nothin'*?" she snapped, advancing on him and balling her fists like she planned to beat the answer out of him. "What's the fucking problem?"

Woody blinked up at her in surprise. "Hey! Chill out."

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"Shit," she muttered, dropping heavily into the chair next to him. "Sorry." Threatening to hit someone in a wheelchair was a new low. What was next? Deciding to lose weight on the Fabulous Dr. Mengele Puppy & Kitten Diet?

"Things a little rocky?" he asked gently.

She scrubbed her face with her hands. "My life's a gravel pit. Taz is acting mad at me and she's shut me out. Everything I do to help just seems to make things worse. I'm beginning to wonder if that flash I had was just a brain bubble. There's all sorts of rumors festering up faster than I can squash them. She's dead. She's horribly disfigured. She's attempted suicide. One of the tabloids claims they have proof she's here and being turned into some sort of singing Robocop." A mordant chuckle escaped her. "They even have actual unretouched photographs."

Woody gave here a one-armed hug. "I know you're having a rough time, Cassie-o." His smile turned rueful. "You know that thing they say about problems being opportunities in disguise?"

"Yeah," she answered unhappily.

"Well, I guess we got us a big opportunity here." He used his free hand to point at one of the monitors. "She's refusing to begin work on the phonemes."

"She said she wouldn't do it?"

"She hasn't said jack. She just sits there. She's all wired up and ready to go, but Sarah can't get her to open her mouth."

Cass rubbed at one aching temple. "Great. Haven't you ever had this problem before?"

He shook his head. "Nope. The thing is, not being able to talk—to *communicate*—is frustrating as hell. It's easy to forget just how much a part of our lives it is. It's how we connect with each other and how we define ourselves. People who've lost the power of speech usually jump at the chance to get it back. They've got things to say, and they can't wait to get them out. The drive to communicate is at least as powerful as the urge for sex. Probably stronger. Celibacy is a walk on the beach compared to enforced silence. Communication can even be considered the primal intimacy; we need it to grow and stay sane."

Cass bit back on the impulse to tell him what was needed was a plan of action, not a philosophy. "What do you think Taz's problem is?" she asked tightly.

"I don't know her well enough to say for sure. Fatalism isn't all that unusual in people who've been attacked and suffered a trauma like hers. Maybe she's surrendered to defeat. She knows she'll never fly again so she refuses to even try to crawl. Maybe she's so messed up inside she can't try. Maybe she's punishing herself. Maybe all of the above and who knows what else."

Cass stared at Taz's image on the screen, her head pounding dully. She had her arms crossed and her lower lip stuck out like a pouting child. A seething acid wave of anger and resentment rose up inside her.

You spoiled, self-centered little

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brat! I've busted my hump trying to help you and this *is the thanks I get?* Her jaw clamped tight and her eyes narrowed. *I'm beginning to think what you need is a good slap in the face. That'd make you open your goddamn mouth, wouldn't it? Or maybe I should—*

The anger fragmented into dismay with a suddenness that left her feeling sick to her stomach. She swallowed back the bitter knot in her throat, appalled at herself.

But in that one unguarded moment she had seen what had to be done. It was an extreme, and it was going to hurt, and just like when she had put a knife to Taz's throat it had to be done *now,* before second thoughts could keep her from carrying it through.

"The computer will respond if she tries to make a sound?" she asked as she lurched out of her chair.

"Yeah, but—"

"Can you pipe sound in there from here?"

"Sure, but—"

She headed for the door. "Wait right here. I'll be back in a couple minutes."

More running. This job was going to kill her yet.

Topaz sat there in Sarah's cheerful, plant-filled work space, a microphone aimed at her face like a gun.

It seemed like each and every night brought less sleep and more bad dreams. Last night had been the worst one yet, the man with the bat lurking there behind her lids every time exhaustion dragged her eyes shut. In one he'd been waiting there on stage while Cass pushed her from behind toward the spotlight, refusing to acknowledge that her lips had been sewn shut, grinning—

The morning had begun with Cass mooching around the breakfast table like some big stupid dog that'd been kicked. The damn piano had flowers on it, just like an arrangement on a casket. The aide who walked her here had treated her like some sort of spun-glass cripple. Sarah was so bright and cheerful about what they were going to do it made her want to puke. She'd been forced to endure having stuff stuck to her throat and then be wired up like a frigging Christmas tree.

Then Sarah had plunked that microphone down in front of her. It wasn't even *hooked* to anything.

That was the last straw.

Once she'd been able to step up to a mike, plant her feet, and pour her heart and soul—her *self*—into it in an act that was as natural as breathing, and so fulfilling and uplifting that it made her feel like a wind-filled kite lifting toward the Sun.

Now she was supposed to sit here before a dead mike and make *muh muh muh* sounds like some baby struggling for its very first word. She wouldn't. She *couldn't.*

Sarah sat at her desk, pretending to do some paperwork while she waited for a certain ingrateful, uncooperative bitch to quit throwing tantrums and play her little game. Topaz watched her out of the corner of her eye. Just like it seemed to have done every third heartbeat since the attack,

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her mood swung crazily between rage, apathy, and despair.

A muted click came from somewhere overhead. She looked up, for the first time noticing speaker grilles in the ceiling above her. Seconds later music began pouring down from them.

The bottom dropped out of her stomach as she recognized the shimmering piano and cello intro to "Moonbather's Rhapsody."

She looked around in wild-eyed desperation, vainly seeking the music's source. Her whole body tensed as if to take a blow, anticipating the hated sound of her own voice. The bars counted on down, five, four, three—

There was no place to hide. She shook her head from side to side in denial as her voice washed over her in a low, sultry tide, the words a pulsing sensual incantation.

"Night into the night into the light into the silver light bright delight streaming silver from the moon the waiting moon the laughing moon—"

She clapped her hands over her ears to shut the sound out but the speakers above her blared louder, her voice leaking through her fingers in insinuating mockery—

"—the dreaming moon silver light streaming onto the skin like wine—"

The small whimper that was wrung out between her clenched teeth came out of another speaker somewhere, a tin dart fired into the beating heart of the music, marring the smooth perfection that was now forever beyond her.

She sucked in a lungful of air hungrily, not knowing, not caring what the stuff wired to her would make of a scream.

The anguished hiss she let out was translated into a shrill, inarticulate yowl that chopped into the music like an axe, ripping a swath through it. But the music closed in after, louder yet.

Her hands clenching into fists; she lurched to her feet as another cry was torn from her useless throat. Once again it was brought to tinny life by machinery.

"Stop!"

The sound—the *word*— shocked her. Inside something shivered and began to crumble. As if that one word had made the fatal crack in a dam, more words came boiling out after.

"Stop, dam-mit stop! It hurts and I can-t—it-s too—pl-ease, oh God I—pl-ease pl-ease STOP!"

That last appeal was delivered to a ringing silence. The music had stopped.

Topaz stood there, swaying drunkenly as she realized what she had done, then buried her face in her hands. Sarah was in front of her by then, taking her by the shoulders. "Are you all right?" she asked.

She hid her face against the woman's breast, let herself be held. "I-m sor-ry," the computer voice said, its flat tone unable to convey how much she meant it. "I-m so sor-ry, I—"

The words continued to bubble out of her in a halting flow, finally easing the terrible pressure which had built so high that she had been inside it rather than it inside her.

* * *

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Woody settled back in his wheelchair, eyes on the monitor and a bemused expression his his face. "Well, look who's talking," he said quietly.

Cass lunged to her feet and fled the observation room, stiff-arming the door out of her way.

One time when she was thirteen Topaz's father had slapped her face. The only time he had ever laid anything other than a gentle hand on her. She had never forgotten it, and now she was thinking about it once more.

The only child of parents devoted to her and each other, Topaz had enjoyed a pretty happy childhood. But it wasn't always easy having parents of mixed race. Parents who were different.

Still, it hadn't really been any big deal until tall, red-haired and handsome Billy O'Rourke had transferred to her seventh grade class. It had begun as love at first sight.

Topaz had been lucky. She'd somehow avoided that gawky, ugly duckling stage some girls suffer while trying to navigate that stormy, rocky gulf between being a girl and a young woman. She hadn't been the cutest girl in class, but she was in the top ten. Before long Billy had started checking her out. Doing goofy stuff when he had her attention. Bumping into her in the halls. The usual awkward adolescent courtship rites.

Being thirteen and in love can be a terrible and wonderful thing. She'd been sure she'd found her Prince Charming.

That was until Billy found out that her coppery skin color didn't come from the sun or a tanning booth. It came from having a black father and a Vietnamese mother. She'd met an entirely different Billy then, an unsuspected Billy, one who sneered at her and used words like *nigger* and *gook* as he said things that cut to the bone.

When you are thirteen you want to be liked and loved and accepted more than anything else in the whole world. When you're thirteen and in love the sudden vicious cruelty of the one whose name covers your notebooks and is written on your heart in glowing neon letters a mile high is the end of the world.

When you're thirteen and in love and have had your heart broken because of who and what your parents are, you go a little crazy and strike out, using words you've seen and heard but *never* before thought to apply to them. Ugly words. Hateful words. Hurtful words.

And when your father looks at you with tears of hurt surprise in his eyes, and slaps you, it brings you up short. It makes you think.

Maybe you learn yet another lesson about love.

Not long after Topaz had pulled herself back together she'd realized that only one person could have been behind the music. The only person who knew about the fit she'd pitched back at the hospital.

Cass.

The corrosive bitterness which had poisoned her blood since the attack wanted her to believe that Cass had done it to be cruel. For revenge.

But in the end she could no more believe that than she could believe

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Cass had pinned her to the sidewalk and cut a hole in her throat just to see her bleed. That her father had slapped her because he hated her.

Sometimes you have to slap the one you love to wake them up. Sometimes it takes a slap in the face to make you stop and look at what you're doing.

When she let herself back into their suite late that afternoon, a thin, brittle glaze of resentment still remained, but she knew that came more from shame than anything else.

There was no sign of Cass in the living room. She crossed to her bedroom door and tried the knob. It was locked. She rattled the knob harder and tried to call her name. Only a faint sighing came out; a breath empty of meaning, a lip-synch with a sound heard only in her head.

"Go 'way!" Cass called from inside, her voice muffled by the door between them. "I'll be out inna while! You c'n fire me then!" She sounded drunk.

Topaz stood there, hand splayed on the door, biting her lip. At that moment being able to talk seemed even more important than being able to sing. There was so much she had to say to Cass, the things left unsaid had piled up like stones in a wall. No wonder their relationship had broken down, they hadn't been communicating. Cass had kept trying, reaching out time and time again. It was she who had withdrawn, pulling into her shell like a wounded turtle and snapping at anyone who came near.

Topaz took her hand off the door. How could she say what needed to be said? How could she break the silence?

Looking around the room she saw one way it could be done.

Cass sat on the floor, her back against the side of the bed. She took another swig from the scotch bottle that had been keeping her company since the middle of the afternoon.

Who but Johnny Walker would want to hang out with Cass Morgenstern? Personal manager of the famed Marquis de Sade School. Johnny didn't mind.

Manipulating Taz was part of her job. Getting her to meet schedules and deadlines. Chilling her out or pumping her up when touring or publicity stops got to her. Finessing her into paying at least minimal attention to the Right People and steering her away from the Wrong People.

She knew Taz couldn't live out the rest of her life keeping some sort of fucked up vow of silence. Communicating was her life, and she had to start putting that life back together. Which meant breaking the silence. Since she wouldn't or couldn't do it on her own, that meant she needed a push.

That was Cass' job. To push.

But you went too far this time, old girl. Way too far.

Taz wasn't stupid. She'd know who had tormented her with her own voice.

Cass peered at her watch. Any time now she'll come back from her session and fire my fat useless ass. Another slug of scotch as she peered around the room, thinking about how

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she could probably still be packed and gone first.

"No," she muttered with a shake of her head. Taz had earned the right to fire her, and she would be enough of a mensch to take it. She owed her that.

The doorknob rattled. Her heart sank. She wasn't ready yet. The knob rattled again, more insistently. *Let me in!*

"Go 'way!" she bawled. She hugged herself as if keeping herself together so she could get the next words out. "I'll be out inna while! You c'n fire me then!"

No response.

She took another swig, then lit a fresh cigarette from the butt of her last. Once she finished it she'd go face the firing squad. Don't want to keep the poor kid waiting. . . .

Her mouth twisted into a bitter smile as she exhaled. It was funny. She'd spent most of the afternoon trying to think about what she was going to do next—after all, she was broke and out of a job—but her mind kept returning to Taz's situation.

If her recording career was truly over then her money would have to be managed very carefully. Her label was already talking about releasing a couple of farewell compilations, and it would take close watching to make sure she got her fair share, and that they met the standards of her earlier releases. Her old label would probably try the same thing and need even closer watching. The media was still hovering around out there like a pack of vultures. Maybe she would stay here long enough to regain the ability to speak, but no one was going to be trying to find a way to make it so she could sing again.

It was so hilarious that it made her want to let out a technicolor chuckle. Even now she believed it was possible. Even now.

Cass sighed, her head lolling back against the mattress. *Maybe the problem was mine all along. I just couldn't face reality, and now that weakness has cost everything.*

She rolled her head back up and lifted the bottle. About two more slugs and she'd be ready go out there and face the music. *Ha ha.*

She froze with the bottle halfway to her lips, a chill skittering up her spine. Listening.

To a familiar tune being played on the piano in the other room.

Topaz perched nervously on the wide padded bench and just stared at the gleaming white and black keys before her. She knew simply touching them would be like letting a genie out of a bottle. An impotent genie capable of granting only certain wishes.

She licked her lips and flexed her fingers. They itched to do the work they knew so well, and the keys pulled at them, exerting a magnetism that reached deep inside her to that buried and barricaded place where music sprang from. The restless ghosts of melodies stirred, aching to come out, to form themselves around the pain and confusion of the last few days like pearls around sharp-edged grains of sand.

But she couldn't play her own music, not yet. Just as it had been with

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the death of her parents, the wound was too fresh and raw. It was going to take time before that brought anything but a sense of wrenching loss.

Another's music then. She closed her eyes, snatches of favorite songs flitting through her mind like butterflies. So many choices, and which one would say what she needed to say?

She couldn't decide so she let her hands fall and do what they would.

Had it been possible she would have laughed aloud when the first notes sounded. In delight, for the Steinway had the pure, resonant voice of a god trapped in wood and steel as it spoke the intro, and in amusement she recognized the tune her subconscious had chosen. The notes rang out dark and sweet as red wine, then in her head she heard the magical, inimitable voices of Maggie Terre and Suzzy Roche as they hit their mark in the melody: *The time/ has come/for me/to speak—*

Her hands hesitated as the phrase faded, then swept toward opposite ends of the keyboard and began playing something different.

Something *new.*

No, a small voice inside her head wailed in dismay, but she could no more stop what had been begun than she could have stilled the beating of her heart. For the second time that day an inner dam had been breached, and there was no stopping what poured out.

Her left hand had begun pounding out a low, arrythmic, angry sound, all harsh words and slamming doors. Her right hand began picking high, uncertain notes out of the air, all crippled flats and sharps in search of a friendly chord. Slowly, painfully they modulated into naturals and began finding some tentative structure, but by then the furious bass line had changed to dissonant flattened minors that tried to shout them down.

Little by little the single notes worked their way down the scale in a melodic line of slowly unfolding complexity.

She heard Cass' door open behind her, sensed her approach. But her eyes remained tightly closed and her soul fused with her hands. The central melody grew more complex; it still had a wistful edge, but at its core there was a growing certainty.

Then words to fit the music unearthed themselves inside her like dusty diamonds.

The sun and sky had fallen/I hid my eyes in fear/sure the dark would never never never end—

The bench creaked as Cass sat down beside her. She felt her old friend's familiar warmth, smelled whiskey and cigarettes.

Little by little her rampaging left hand was tamed by her right. Harmony crept in. Dissonance dried like tears.

—Maybe the sun and sky have fallen/maybe all I knew is gone/still a new dawn breaks over the ruins/the midnight of my soul tolls no longer/ because I feel your hand in mine, my friend.

There was more of it, and it was rough as hell, crying out to be rewritten and polished until every note and word was perfect, but now she could let it go. She could put it aside.

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Topaz brought her hands down in a final unresolved chord.

Beside her Cass sniffled.

A half-smile quirking her lips, she pecked out a snatch of an old song from her first album with her right hand as she turned her head to look at Cass.

—So is it you and me, sport, or should I get me a dog?—

Cass' eyes were red and brimming with tears. She nodded solemnly. "If you'll still have me."

The wall Topaz had put up to hide behind came all the way down then. She stepped over the rubble by putting her arms around the bigger woman and holding her tight. Cass bear-hugged her back.

The two old friends held each other and cried. For several minutes no word was spoken. Not because they had fallen back on wordlessness, but because they had gone beyond it.

If a picture can be worth a thousand words, then one loving, forgiving embrace can be worth a thousand pictures.

That night Topaz still had nightmares, but some sort of threshold seemed to have been passed. They were fewer and briefer, and for the first night since she was attacked her sleep was more restful than harrowing.

Over the next few days she applied herself to her part of helping create her speech paradigms with an almost monomaniacal intensity. She worked tirelessly at drilling the phonemes, pushing Sarah so hard that she came down with a slight case of laryngitis.

As for Cass' promise that this would somehow lead to her being able to sing again, well, she let that slide.

The promise had been made with the best intentions, and she figured Cass needed to cling to that illusion for a little while longer. Cass was a realist. She'd come around sooner or later.

Cass got in the habit of visiting the Speech Lab at least twice each day. She no longer had to hide in the observation room. Topaz was glad to have her see how well she was doing.

On an afternoon five days into the process, Cass took a break from the endless phone calls and e-mailing and faxes that kept as many plates as possible still spinning, and dropped by. Woody joined her, gazing fondly at their star pupil.

"She's really amazing," he said quietly. "At the rate she's going we'll have everything we need to program her voice chip in another couple of days or so. Most subjects can drill for only about two hours before they lose their concentration and begin making mistakes. We always figured if we got three or four usable hours out of a day we were doing real good. Not her. At the end of eight she might be tired, but her ear and enunciation are sharp as ever. Not only has she got stamina, she's got control."

Cass smiled. "You have to remember that her voice has been trained, and she's worked it hard all her life. I've seen her spend ten hours in the studio laying down forty separate vocal tracks, never once using one already recorded as a guide, or even

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anything to give her a beat to follow. When they were played back all at once they fit together just like a jigsaw puzzle. . . ." Her voice trailed away uncertainly.

Woody peered up at her, a question—*the* question—in his eyes. "Got something, babe?"

She shook her head slowly. *Jigsaw puzzle?*

"It's gone again." She thumped her forehead with the heel of her hand. "Maybe if I put a quarter in my ear something would come out."

That made him laugh. "Hey, it just might."

"But it would probably just be a gumball."

After supper that night Topaz went to the piano, just like she had been doing every night since she had first played it.

Cass sprawled on the couch, savoring one last cup of coffee as she soaked in the music and read. After a few minutes the playing stopped. She looked up from her book when she heard Taz sigh. "Problem?"

Taz turned to face her. A plastic box the size of a paperback hung around her neck, the electrodes running up her neck wired to it. "Kind of." When her mouth moved a toneless synthesized voice came from the laptop and soundbox parked atop the piano. It was a crude temporary setup, but if freed her from the talkboard.

"Can—can I ask you some-thing Cass?"

Cass put down her book and sat up straighter. "Shoot."

"Pr-omise you won-t get mad?"

"Cross my heart."

Topaz took a deep breath. "I really love this pi-ano, Cass. It-s beau-tiful. But I kind-a wish I had my MIDI set-up from home. I-m . . ." She bit her lip and lowered her eyes, as if about to confess some shameful secret. "Well, I-m writ-ing some songs."

Cass smiled and said, "That's great Taz," in a mildly pleased voice, even though what she really wanted to do was leap off the couch and run around the room yelling *Yes! Yes! YES!* at the top of her lungs.

"It-d be eas-ier with my st-uff," Taz went on hopefully. "I could pr-int out sheet mu-sic and use the syn-th and sam-ple to play dif-fer-ent parts. I could ev-en . . ." She shrugged.

"What?" Cass prompted gently.

"I could ev-en use that dig-it-al loop pro-gram we used on 'My Robot Self' to kind-a, well, fake my own voice."

The rising happiness Cass was feeling turned to something else altogether in an instant. Her heart seemed to stop mid-beat. All expression drained from her face.

"Oh shit," she said in a faint reedy voice.

Topaz stared at her uncertainly. "Are you OK?"

"Oh shit . . ." She rubbed her open mouth with her hand.

"Cass! What-s wrong?" Topaz cried, knocking the piano bench over in her haste to get up. "Are you hav-ing a heart at-tack?" She sprinted to the couch and grabbed her by the shoulders. "Cass?"

The big woman stared in her direc-

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tion blindly, her face surprised and strange. Her mouth worked soundlessly a moment, then she whispered, "Oh shit," again.

Topaz's fingers dug into Cass's meaty shoulders. "Jes-us, Cass, you-re scar-ing me!" she wailed, her voice still coming back from the piano, as if she had left it behind in her haste.

Cass focused on her face at last. "Shit, oh goodness," she rasped, at least changing her tune. A grin crept out onto her face, and it just kept getting brighter and wider.

"What is it?" Topaz cried. "Tell me!"

"Whooo-*ha!*" Cass bellowed, coming up off the couch like a charging bear and sweeping the smaller woman off her feet. She began whirling Topaz around the room with her toes a good six inches off the floor, laughing and whooping like a maniac the whole time.

Suddenly she put Topaz down and began pacing back across the room, hands on her forehead.

"New York or LA?" she asked the ceiling. "New York is better but LA is closer. FedEx can do the rest. Right." She stopped, spun on her heel and headed back the way she came. "Who to call? Jimmy Witherspoon. Bug Slowdowsky. Maybe Hiro Kanata. Wendy Carlos said anything we needed. . . ." Stop. Turn. Pace. "Hell. Skyler's gonna blow a fuse. No doubt about it. Another mil should keep him out of our faces." Stop. Turn. Pace. "Better handle him in person. Woody I can call on my way to the plane. Or should I drive?" Stop. Turn—

"What the hell are you *talk-ing* about?" Topaz demanded, planting herself in Cass' path. "Tell me!"

Cass stared at her, her face softening. "I finally got it. I think—I think I see how you can sing again."

All expression fled from Topaz's face. "How?" she whispered, the computer voice a harsh rattle.

"You said it yourself. 'My Robot Self.'"

Taz shook her head. "I st-ill don't—"

"We didn't record what you sang. Remember? Jimmy and Bug helped set it up so that you used your voice like a keyboard, to trigger synthed samples of your singing from completely different songs."

It was Topaz's turn to go wide-eyed as she realized what Cass was suggesting. She touched the electrodes on her neck, questioningly.

Cass nodded. "I want you to keep working with Sarah and Woody, get speech nailed down. I hope you'll let them put in those subcutaneous throat implants—they're higher definition than those stick-on thingies. I'll be back in—" She shrugged helplessly. "I don't know. Two or three days. I've got to find Bug and Jimmy, get them to drop whatever they're doing, get a truckload of equipment together, and all your—"

"I get the pic-ture." Topaz looked Cass straight in the eye, a hopeful, fearful expression on her face. "Do you—do you real-ly think it will work?"

Cass closed her eyes, her certainty sagging. For just a moment she looked very old and very unsure of herself. Then the old Cass reasserted herself. Her face firmed up and she

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met Topaz's gaze squarely.

"I don't know. I shouldn't have promised it before, and I can't promise it now. But I think it will. I think it's worth trying."

Topaz nodded solemnly, thinking of all the unsung words bubbling up with the music inside her. Even if it didn't work very well, it would still give her some small measure of what she'd once had. Anything had to be better than nothing.

Just like with reconstructing her ability to speak, there would be limitations. The thing was to keep trying to overcome those limitations, not let them overcome her.

"So do I," she said. "So?"

Cass frowned. "So what?"

Topaz laughed, the rattling wound the computer made striking sympathetic notes from the piano. "So what the hell are you do-ing still hang-ing ar-ound here?"

The Cass Morgenstern Express was packed and in motion less than five minutes later. She tracked Henry Skyler to the small but well-equipped studio where his production crew turned out videos promoting the work—and the profitable potential thereof—of the Skyler Institute in general, and Skyler himself in particular. She bulldozed her way past two secretaries, an executive assistant and a security guard to get in.

Skyler had been in a director's chair with his name on the back in gold, and a bib around his neck as a makeup woman fussed over him. Cass had sent her twittering for cover, planted herself in front of him, and laid out what she wanted. Every time he tried to interrupt she pushed her face closer to his, and in the end he had to shut up and listen or lose his nose.

"You want to *what?*" he demanded when she stepped back to let a bit of slack in his chain.

She shook her head. "Don't play that Edison riff too hard. You aren't deaf. You heard every word I said." To help cultivate a public image as the "Edison of Physiological Re-empowerment" he'd had his pate shaved back and his hair bleached white. There were even rumors of plastic surgery to heighten the resemblance.

"Now you listen to me, young lady," he warned, wattles quivering and his hands gripping the arms of his chair. "I don't have to—"

Cass got right down into his face again. "I don't have time to fuck with you, Hank," she said heavily. "So here's the deal. I'm going to be back in about three days with a truckload of equipment and a couple people to help run it. The whole Speech Lab is ours for as long as we need it. That includes Woody, Sarah, and anybody else we want. No publicity, no jogging our elbows. We think we're onto something, and the last thing we need is a clown like you pissing into what we're trying to cook up."

She straightened up and reached into her pocket. "Here's a check for five hundred thousand dollars." She held the check toward him, reading the greed in his eyes. "Think of it as an advance. If what we're going to try works this dump is going to have money and publicity coming out the wazoo."

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He frowned up at her, not letting his gaze stray too far from the money. "This is a research facility, young lady," he said in what was supposed to pass for an indignant tone. "Surely you don't think you can just hand me that check and expect me to let you turn one of my labs into some sort of rock and roll circus."

"Of course not. I know you better than that, Hank," Cass said sweetly. She pulled her phone out of her pocket and offered it with her other hand. "I've already set up an EFT in your name to the tune of another five hundred grand. All you have to do is punch in the destination code of your numbered account."

Skyler stared at her hands, licking his thin lips. Before a count of five could pass he emptied them both. The check went into his pocket. He turned his back on Cass as he punched the numbers into the phone's keypad. When it beeped to signal that the transfer had been made he returned it to her.

Cass slipped it back into her pocket. "Cayman Islands?"

Skyler chuckled. "Switzerland." He waved the makeup woman back over. "Now if you will excuse me? I have a video to make."

Cass grinned at him. "Break a leg." She turned on her heel and strode away. "Break both while you're at it, schmuck," she added under her breath.

The Cass Morgenstern Express was back on the road and running in high gear by the time she hit the door.

"Nervous?"

Topaz gave Cass an uncertain smile. "A little."

The two women were facing a semicircle of so much equipment that it looked like they had wandered into some sort of Mission Control by accident. Taped-down cables vined the floor. A combination of a 100° day outside and the heat generated by all the equipment had the air conditioning running at full blast just to keep the speech lab in the high seventies. Most other lab projects had been moved to another room to clear space for what they were doing.

Topaz was perched on a padded stool, a cold soda in her hand. Before her was a microphone on a stand. It wasn't hooked to anything, but it would give her a point of focus. She wore only sandals, shorts, and a sleeveless red blouse knotted at the midriff. Sweat beaded her skin, not all of it due to the heat.

Now when she spoke, it was through the gleaming black pendant. While her voice was smoothly feminine, it was still unmistakably synthetic. Although the device allowed her to speak without anything else hooked to it, only its receiving circuits would be used when she tried to sing. A ribbon cable sprouted from its back, running to the cigarette-pack sized plastic box taped to it. More wires led from that to the thumb button control in her hand and another paperback-sized module clipped to her belt. The sweat made the tiny incisions where her throat implants were itch under their Band-Aids.

"Almost ready, Taz," Woody called encouragingly. He looked tired, but

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excited. The deep bags under his eyes had been put there by working with two of the Institute's programmers nearly around the clock to modify the speech software to this new use.

Bug Slowdowsky's heavily made up green eyes appeared over the top of one of her computer monitors. Standing just a hair over four feet tall, her bright orange dreadlocks framed the face of a demented cherub. She had a reputation for being somewhat abrasive, but what she didn't know about the interfacing of music and computers to shape sound wasn't worth knowing.

"I'm ready to give this junk pile a try," she drawled. She waved a chubby, ring-covered hand toward the blade-thin, shirtless black man at the equipment-laden table next to her. "We's just waitin' for Jimmy to get his shit together."

"Eat my shorts, Bug." Witherspoon peered at Topaz though bottle-bottom tinted glasses. Sweat gleamed on his shaved head. "I'm ready." He waved at the stacks of ROM archive boxes, floptical drives, and Magnacards patched to an over-sized desktop computer built into an Anvil case.

"The thing is, we've got almost too much stuff on hand. I've tried to organize it like Woody and Sarah suggested, but even so the first searches and matches will be slow." He grinned, revealing diamond-studded incisors. "Once we get rolling I can tweak my search-progs and it'll speed up." Jimmy's specialty was sampling; the locating and extracting of the one particular sound needed. His ear was perfect and his memory extraordinary. He already knew every note in two-thirds of the material on hand.

Woody spun his chair toward Sarah, who had been working just as hard as everybody else, roughing out base paradigms for singing. She would be monitoring and adjusting the devices reading what Topaz's voice was trying to do. "You ready to boogie, love?" he asked.

Of all of them, she seemed the least touched by the heat and tension. "Of course." She gave Topaz a serene smile. "OK, Taz, just like before. Take your time. This isn't going to happen overnight."

Topaz nodded back, feeling that flutter she always got just before going out on stage. This time the audience was smaller, but it was the most momentous performance of her life.

Cass' idea had been simple enough, even though it had taken them all several days to prepare to implement it.

The device which now allowed her to speak worked by recognizing the sound she was trying to make and triggering a corresponding phoneme stored in a sound chip.

If that was possible, then why couldn't the act of vocalizing trigger a corresponding digitalized sample of her own singing voice?

At Cass' behest Jimmy had gathered well over a hundred hours of digitalized recordings of Topaz singing. That included the masters from all her studio and concert recordings, outtakes and discards. Recordings from her own home studio. Even warm ups.

Topaz's newly regained confidence had begun to erode as the pile of

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equipment it was taking to give this a try grew in size and complexity day by day. It was beginning to look like singing *Happy Birthday to You* was going to be about as simple and spontaneous as sending a manned spacecraft to Mars.

She had finally confessed her fears to Woody and Cass. Woody had explained that like what they had done with speech, once they had her voice plotted out the paradigms and the equipment needed to reproduce them would be much smaller and simpler.

How much smaller? There was no way to tell yet. Singing was considerably more complex than speaking, and the more that they tried to recapture of the extraordinary range she'd once had, the more memory they were going to need. Singing was going to take one—more likely two—very fast computers, a bank of signal processors, one hell of a lot of very fast memory, and at least one person to keep the system tweaked to optimum.

"So much for singing on street corners," she'd joked weakly, still dismayed by the prospect.

Then Cass, her Cass who had started all this and kept it moving by force of will, had put her arm around her.

"Woody said that for you to sing we had to build a grand piano." She said, gesturing dismissively at all the red ready lights and glowing computer screens. "That's what we're building you now. A serious musical instrument. It'll be smaller once we get it figured out and stuffed into a box, but even if it isn't exactly portable, who the hell cares? Neither's that Steinway. Why'd you think God made trucks and roadies?"

Topaz gazed at those gathered to help her. They were waiting for her to begin.

Well, here goes nothing.

She took a deep breath and put down her soda. "OK, kiddies. Plain vanilla middle C coming up."

Cass crossed her fingers and waited. Beside her Taz took another deep breath. She stared at Taz's favorite old Klipsh speakers, shipped from her basement studio back in New York, trying to will the sound she wanted to hear from them.

The sound they spat out a second later made her wince. It was beyond awful; it sounded like Taz had tried to sing while gargling gravel jello. She peeked fearfully at the singer, trying to find words to ease her disappointment.

To her surprise Taz threw back her head and laughed.

"Sorry, folks," she gasped at last. "My fault." she held up the pushbutton control in her hand. "I forgot to switch over from the speech circuits."

Cass let out a sigh of relief. She wasn't the only one.

"Let's give it another shot." Topaz held the control out and made a big show out of putting her thumb on the button. Then she took a breath, opened her mouth and let it back out in a voiceless hiss.

A fraction of a second later the pure perfect voice of Topaz Baldwin blared from the speakers like a trium-

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phant trumpet. Cass shivered as the brassy note hung there in the air several seconds, then died.

Topaz stepped back from the mike, her dark eyes closed and her face expressionless.

Cass waited, almost afraid to breathe. Bug's dreadlocked head popped into view. Jimmy stood there with his arms crossed before his bare chest, patiently waiting for the verdict. Sarah pushed her salt and pepper hair back, a hopeful smile on her face.

"Well?" Woody asked. "Did we wipe out?"

"It needs to be fuller and softer," Topaz said at last. She opened her eyes. "Sarah, I think you're reading me as pushing a lot harder than I really am, and it's a softer, more open sound. Bug, it's got too much brass, it's more pipe. The note was right on, Jimmy, but I was using more the voice I used on *Cassandra*."

That set off a flurry of activity. Cass waited it out, wishing she could light a cigarette. Topaz watched them work, her face placid.

"Ready to try again," Woody reported at last.

Topaz nodded, took a breath, and tried again.

This time her voice rolled out of the speakers like a velvet wave. Topaz made a lowering gesture toward Sarah. The volume dropped and it became softer. She made a flattening gesture toward Bug, and a second later some of the overtone faded, leaving a note as clear as glass. Still

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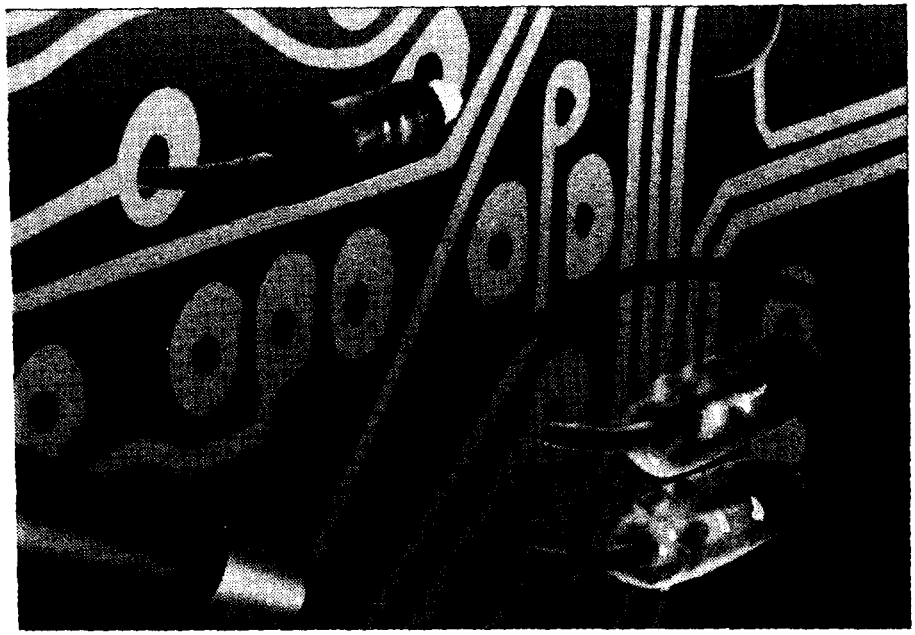

she held the note, her head rolling back and her eyes closing, at last letting it trail away to silence.

Cass wiped her sweaty hands on her jeans, her heart in her mouth.

Topaz stepped back from the mike. She took her thumb off the button. She opened her eyes and smiled.

"That's a take," she said.

Topaz's nightmares had leveled off at about one each night when she started up the road to recovering her speech.

That night she slept deeply and peacefully, the man with the bat banished from her dreams at last.

It was well past three in the morning when Cass slipped quietly into their suite several nights later. She was wiped out from the long drive to Reno and back, but it had been worth the trip. It was a good tired. There was a pleased smile on her face, put there by the day's end.

The late morning, afternoon, and early evening had been spent in meetings. She had gotten Taz's label to hold off starting on a farewell compilation for another month, and made sure the lawyers keeping her old label from releasing one were on their toes. She had met with money people, a couple of sympathetic journalists, and put the kibosh on yet another attempt at an unauthorized "Topaz Baldwin Story" movie of the week.

Then, just when she had thought the meetings were over a shy, uncertain voice coming from behind her had asked if she, um, had any plans

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for, well, dinner?

Dr. Sid Braddock had been calling her every so often, ostensibly to check on his former patient's progress. She didn't remember mentioning the trip to Reno, but she must have because the sly little devil had taken the day off and flown out. He'd hung around all afternoon and early evening hoping for a chance to spend some time with her.

Dinner had been late and lovely, candle-lit and *very* romantic. Cass would have been sorely tempted to share a horizontal aperitif with him afterward, but he had to catch the midnight flight back East. She could still feel his goodbye kiss on her lips.

She closed the door quietly behind her, turned around.

"The prodigal manager returns."

It was Topaz's electronic voice. She was sitting at the piano, the moonlight streaming in the sliding glass doors painting her hair silver.

"What're you still doing up?" she asked, hoping it wasn't a recurrence of the nightmares that had plagued her earlier.

"Waiting for you," Taz patted the bench beside her. "Come here a minute."

Cass crossed the room and dropped onto the bench with a sigh. "Something wrong, hon?"

"The gang thinks I'll have maybe 90 percent of my voice nailed down in another couple of weeks. The rest will be spots we won't know about 'til we hit them."

"I knew that," Cass said, wondering what she was getting at. Her face gave no clues.

"Today I asked Jimmy and Bug if they'd work with me for at least the next six months. They both said yes."

Cass frowned. "You think it'll take that long to get all the kinks out of your voice?"

Topaz shook her head. "No, but it may take that long to record my next album."

Cass stared at her, her mouth hanging open. "Really?" she managed at last.

A coy smile. "Well, it might take longer. . . ."

"No, I mean you *really* want to record again?"

"Now Cass," she said in a tone of fond exasperation as she patted the big red Steinway. "What the hell's the sense of having two grand pianos and not making music with them?"

The applause died down as Topaz adjusted the microphone so it was pointed at her throat. She patted the small black box at her hip, laid her small hands atop the glass podium and began to speak.

"First I want to thank all of you for picking 'Songs from a Broken Instrument' as Album of the Year."

The people in the audience and watching the show at home heard a very good simulacrum of her natural voice. Other than a slight tinny edge, her speaking voice was much the same one she'd had before the attack.

Woody, Sarah, and their people, had carried the idea that let Topaz sing to its logical conclusion, coming up with a way to use a sampled human voice for speaking instead of an artificial one. In Topaz's case they had

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been able to reconstruct her voice from dozens of hours of recordings of studio chatter and interviews. For others with no sample to work from there was already a growing library of voices to choose from and modify. The amount of memory this process took still wouldn't fit into the pendant at her throat, but did fit quite neatly into the small device at her hip.

"Everyone who comes up here always says that they want to share the credit for this honor." She grinned impishly. "It's a good thing there's no lie detector built into this podium."

When the laughter and applause died down her expression turned serious. "In my case it's true. I wouldn't be up here if it were not for the help of several people. Now Henry Skyler couldn't be here tonight—"

—Because Cass had arranged for Raul Faoud, manager of the Hebrab band Camel Lip Kiss to be in Skyler's office at this very moment, passing himself off as a Kuwaiti sheik with barrels of oil money and interest in investing in the very lucrative cybernetic prosthetics market.

"—but Dr. Woody Entwhistle and Dr. Sarah Bright of the Skyler Institute are here, and it was their pioneering work which made me possible." Sarah half stood and Woody waved a peace-sign in the air to a round of applause.

"Hiding in the back of the curtain behind me are Jimmy Witherspoon and Bug Slowdowsky, two very talented people who helped get this cyborg songbird built and keep her warbling. They're back there getting ready to do that voodoo they do so well." More applause.

Her gaze returned to where Woody and Sarah were seated. "Also here tonight is Dr. Sid Braddock, whose surgical skills and advanced techniques kept me from having to breathe through a hole in my throat the rest of my life. Stand up Sid, show the folks your too cool tux!"

Blushing and looking quite dashing in the pink and black satin tuxedo his fiancée had picked out for him, Braddock stood, ducked his head, and dropped back out of sight.

Topaz gripped the podium tightly, gazing out into the audience. "But if anyone—"

Her voice broke. She shook her head, took a deep breath and tried again. "If anyone deserves most of the credit for my being up here tonight, it's my manager, Cass Morgenstern. Who, by the way, is now engaged to become Mrs. Sid Braddock," She smiled fondly at Cass, her eyes glittering. "Or, if I know my Cass, Sid is going to become Mr. Cass Morgenstern. Would you please stand up, Cass? I'd like these folks to see my best friend ever."

Cass slowly rose to her feet, blushing furiously, the big goofy-looking corsage Sid had brought her proudly pinned to her jacket. The applause became a thundering ovation as one by one the people rose to their feet. She stood there, looking stricken, then sat back down and tried to become invisible.

Sid took her hand and kissed it, beaming with pride.

"So," Topaz said when everyone had returned to their seats. "As you

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know I haven't performed live since my attack. I was asked if I would like to sing tonight. You can't possibly know how glad I was to be able to say yes."

The curtain behind her opened as she turned toward it. Front and center on the amber-lit stage waited the rosewood Steinway.

Cass watched Taz take her place at the big red grand piano. Jimmy, Bug, and the backup musicians were already in place. The house and stage lights dimmed, leaving Taz in a pool of warm golden light. An expectant hush fell.

She looked out into the audience. "This one's for Cass," she said softly, then turned to the keyboard and began the long, aching solo piano intro to "Song from a Broken Instrument."

"You did good, my love," Sid whispered in Cass' ear, squeezing her hand tightly. "I'm so proud I could just plotz."

She nodded, eyes on Taz, determined that she was not going to start bawling. She was Cass Morgenstern, after all. Tough as nails. Soul of a cash register.

But when the petite, dark-haired woman up on the stage opened her mouth and began to sweetly sing, she began to cry.

Once more glad, beyond all containing, that she wouldn't have to endure the silence. ■

(Biolog continued from page 94)
tions awarded for modern military management.

Starting with a technical problem, Gerald works out the complications that are likely to arise, guiding his characters to a resolution that arises from the steps along the way. A first draft tends to be a concise, straightforward account. Rewrites fill in characterization and descriptive details. To Gerald's thinking, this is something like the way a painter works: putting in the sky and background first, then fitting in the central objects, and finally filling out details.

Gerald especially appreciates the early science fiction writers and those of the "Golden Age of SF" here in *Analog* who were scientifically literate. They fired the reader's imagination and scored hits with thoughtful prediction. Writers who hoke up stories with phony science or supernatural interventions do the real world and its people a disservice. Humans deal day-to-day with the results of human ingenuity, whether it's an arrow, a rocket, or genetic engineering. That's what sets humans apart from other animals. Grappling with reality sets science fiction apart from other literature. It's the difference between seeing only where you are and seeing where you're going to be, along with thoughts about how to get there. ■

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THE REFERENCE LIBRARY Tom Easton

Manhattan Transfer, John E. Stith, TOR, $21.95, 381 pp. (ISBN: 0-312-85285-7).
Icarus Descending, Elizabeth Hand, Bantam, $5.99, 335 pp. (ISBN: 0-553-56288-6).
High Steel, Jack C. Haldeman II and Jack Dann, TOR, $18.95, 252 pp. (ISBN: 0-312-93163-8).
Shadow Hunter, Will Baker, Pocket Books, $21, 373 pp. (ISBN: 0-671-79046-3).
Berserker Kill, Fred Saberhagen, TOR, $24.95, 446 pp. (ISBN: 0-312-85266-5).
Conscience of the Beagle, *Patricia* Anthony, First Books (P. O. Box 2449, Woburn, MA 01888; also Wildside Press, 37 Fillmore St., Newark, NJ 07105), $9.99 (trade paper), $21.99 (hb), $40 (signed limited), $75 (signed lettered), 205 pp. (ISBN: 1-880448-29-7 [tp], -30-0 [hb], -31-9 [s,ltd], -32-7 [s,let]).
Empire Builders, Ben Bova, TOR, $21.95, 383 pp. (ISBN: 0-312-85104-9).
Sam Gunn, Unlimited, Ben Bova, Bantam, $5.99, 343 pp. (ISBN: 0-553-56298-4).
Future Earths under South American Skies, Mike Resnick and Gardner Dozois, eds., DAW, $4.99, 316 pp. (ISBN: 0-88677-581-7).

Picture, if you will, great black spaceships hovering over Manhattan. High-intensity laser beams slice helicopters to shreds, halve the Brooklyn Bridge, chop subway trains in two. In the cut appears a seamless black wall. A rigid bubble encloses the island and all its people and buildings—or all those that weren't sitting on the border. Cables run from the bubble to the spaceships, which then pour on the coal and—Lo and behold!—Manhattan rises into the air.

How can you possibly resist? It sounds like one of those commercials for how much more potent radio is than TV. But no, it's the opening of John E. Stith's *Manhattan Transfer.* Very soon Manhattan is ensconced

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inside the mother ship, in a vast chamber that also contains a great number of other bubble-enclosed cities. Mayor Dorine Underwood resolves to cope in the best New York tradition. Super-trooper Matt Sheehan, a colonel with a rep, appears to lend a hand. City workers, journalists, and ordinary citizens display grit and gumption, while a few religious crazies decide that what has happened is due to the hand of God—perhaps it's something like the Rapture—and mere humans should mind their own business and not try to understand or interfere, on penalty of letter bombs and worse.

Just what is going on? Telescopic examination of the other cities shows they are alien, apparently from many worlds. One is broadcasting a record of its abduction that hints that once they were off their homeworld, that homeworld was destroyed. The inevitable conclusion is: "Maybe Earth is still safe. If so, we've got to stop them!"

So. A spot of technical wizardry, please, and here's a nice hole in the impervious bubble. Let's check out a few of the other cities. Here's one whose telepathic inhabitants heard their world die. And here's the wall, an elevator, the spiderlike Archies who turn out to be good guys after all. The bad guys are—Look out! Here they come! Somebody, quick, do something!

And of course the plucky humans do indeed do something to save the day. This is superscience SF in the classic vein, fast-moving, heroic, just barely plausible enough to keep your disbelief hanging in midair, loaded with sensawunda. You'll love it.

Or perhaps you will decide there is a bit too much kinship to the Clarke/Lee *Rama* sequels, as if Stith wanted to show how a little more action and less talk-talk might have improved those books. You might even spot a kinship to Greg Bear's *Forge of God* (et seq.), as if Stith wanted to show how inimical aliens could *really* be fixed. Or maybe Stith is really criticizing the modern tendency to multi-volume epics by showing us how to do four books (at least—don't forget a touch of the old Doc Smith) in one.

Icarus Descending is the third and apparently last (after *Winterlong* and *Aestival Tide*) in Elizabeth Hand's series about a future Earth virtually destroyed by a centuries-long orgy of decadence and war. Her vision is a cynical one; unfortunately, today's news makes it all too easy a vision to comprehend, accept, and even agree with.

Is there any sign of hope? Humans seem dedicated to killing each other with Rains of Roses (viruses and mutagens) and Shinings (nuclear holocausts). Their military heroes, Aviators such as that Margalis Tast'annin who was destroyed in *Winterlong* and revived as a walking corpse in *Aestival Tide*, undergo training designed to purge them of every scrap of human sympathy. Researchers seeking new weapons and tools cruelly exploit innocents such as Wendy Wanders (the star of *Winterlong*) and construct genetic monsters from

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their own children.

Luther Burdock committed that last sin centuries before the story by cloning his beloved daughter. Now she is a horde of giant "energumens," male and female, limited in life to a thousand days, laboring for the Ascendants as soldiers, laborers, and servants. Many are in the orbiting HORUS colonies, where the humans have only just been exterminated and one Kalamat is failing to comprehend a message on a computer screen that says an asteroid—Icarus—is heading for Earth. The reader senses immediately that the end of days is at hand.

Now here is the Aviator Margalis Tast'annin, accompanied by Nefertity, the robot repository of women's myth and knowledge. He seeks another robot, Metatron, repository of military knowledge, and Wendy Wanders who had been rebuilt to kill in dreams. Meanwhile Wendy, who escaped the city that once was Washington, D.C., has found refuge for a brief while, unknowing of the disasters accumulating in the distance or of Margalis's hunt for her. Here is a lengthy recap to be sure that no one has forgotten the first two books, and now here are signs of revolt by energumen and mutants and other victims of the Ascendants, masterminded by Metatron itself. Meanwhile, Icarus approaches, emblem of death, the black eye of fate.

Wendy, discovered in her refuge, is spirited away by rebels. Tast'annin and Nefertity pursue the search for Metatron to the HORUS colonies, are drafted by energumens heading for the rebellion's headquarters in the Blue Ridge mountains. Three volumes' worth of loose threads come together, and then. . . .

I will add nothing more except that it would be nice to be able to say that Hand's bleak pessimist's despair was suddenly replaced by rosy hope. Yet though the final notes she sounds do permit that thought, they also hold the seeds of further oppression, exploitation, and war. I suspect Hand believes humans and all their works are tainted beyond redemption by the human tendency to overweening pride, or hubris.

American Indians[1] have a reputation for being comfortable with high-altitude construction. Jack C. Haldeman II and Jack Dann are not the first to feel the urge to exploit this reputation by putting American Indians into orbit, walking the high steel of powersats and habitats instead of skyscrapers, but their **High Steel** is surely one of the more satisfying products of the urge.

The time of the novel is the not too distant future. National governments are largely subsidiary to over-sized multinational corporations such as Trans-United, which actually have the power to draft workers willy-nilly. John Stranger is a South Dakota Indian in training to be a medicine man. His potential destiny in this spiritual role is immense, but to Trans-United he is just another construction worker—until he displays an aston-

[1]Yes, I know the PC term is "Native Americans," but their ancestors were just as much immigrants as mine. I am as native as they. The real difference is that their ancestors were here first.

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ishing talent for grasping the gestalt of complex situations and doing precisely the right things to halt disaster and save lives.

Trans-United and its kin are cold, unfeeling, anti-spiritual materialists, perfect representatives of the white man's (*wasicun*'s) Earth-despoiling civilization. They manipulate, slaughter to cover up secrets, intrigue and war against each other, and threaten death to friends and kin to force John Stranger to display his talents. He responds by growing ever more impressive, and when Trans-United begins to test his ability to operate the starship they have built from plans received from distant aliens, he....

The end is not hard to predict, which is surely the major weakness of a tale that draws its dramatic power from the opposition of stereotypes—the heartless, rootless white versus the intuitive, in-touch-with-Earth Indian, boss versus worker, powerful versus powerless, materialist versus idealist—without attempting in any substantive way to challenge the appropriateness or justice of those stereotypes. *High Steel* is thus the sort of story that affirms its target audience's prejudices.

There is a similar problem with Will Baker's **Shadow Hunter,** though here there is more recognition of the complexity of real people and real situations.

Baker is a University of California, Davis, creative writing prof, a critic, a novelist, an almond farmer, an outdoorsman, and a "part-time environmental activist," the last has more than a little to do with *Shadow Hunter*. He gives us a future in which the industrialized northern hemisphere has pretty well trashed the planet. The American southwest, Central and South America, and more are radioactive wastelands in which survive only the mutants known as Ginks and a wide variety of wildlife both strange and familiar. Civilization flourishes to the north, urban, regulated, and highly dependent on an agriculture based on pesticides, herbicides, and other chemicals. To some civilized humans, the Ginks and wildlife are prey, to be hunted with assorted weapons more super than the assault rifles beloved of today's macho nutcases. To others, the filthy Ginks, rats, and bugs are threats to civilized existence that must be exterminated or at least seriously reduced in numbers. Indeed, they are more than a little frightened of the way various species seem to cooperate to mess up everything from upholstery to power plants.

The tale begins as Papa Drager takes his son Ronald into the wild for his first hunting trip. Unfortunately, Ginks, bees, and a bear destroy their vehicle, seem to kill Papa, and hie off with Ronald. In due time, he adjusts to life with the Ginks, acquires a second personality or true soul, and begins to accept their way of thinking, in which Nature is a holistic, interactive thing quite reminiscent of Gaia.

Meanwhile, Papa turns out to be alive, albeit horribly scarred. Now vengeful, he switches political sides from conserve (if only for hunting)

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to control-and-exterminate, and allows his personal tragedy to be used to power a political takeover by a media conspiracy. He and his new controllers want to find a dead Ronald. Meanwhile, the entrenched system wishes desperately to find a living Ronald and sends secret agents into the wastelands. The secret agents themselves wish nothing more than a system that will provide them with employment and opportunities to get periodic murderous jollies; Baker devotes a surprising amount of his attention to establishing them as social parasites.

You can see the shape of the tale. The Ginks represent the noble savage, the innocent Third World peasant victimized by the developed world, the ideal of uncorrupted nature, inspirited by mystic emanations from Mother Nature (here represented by ancient termites), intuitive and telepathic. The opposition is science and technology, logic and reason, bureaucracy and control, murder and torture and poison, everything one never, never sees in the Third World.

Did I say that Baker shows more recognition of the complexity of real people and real situations? When I describe what he is saying this way, he sounds as simplistic as anyone could ask. Yet he does see defects in even his own apparent preferred position, and in the end he comes to something of a compromise. Indeed, he says something very like "tree-hugging twits are mad, yet in that madness there is something infinitely precious that could change the world."

Shadow Hunter is quite a thought-provoking work. Its world is a crystallization of our own, its oppositions are familiar and painful to any thinking person, its plot complex and entertaining. It's worth reading.

If there is a serious defect, it is rooted in something he reveals in his acknowledgements page, where he thanks his students for tempting him into writing a book of "unshackled imagination." Having thus abandoned all restraint, he tosses in just a few too many kitchen sinks such as those social parasite secret agents and media conspiracies.

Fred Saberhagen's Berserker series has had quite a long run—in his own novels and short stories as well as in sandbox rentals (aka "shared world" stories). There is obviously something very appealing about the concept of ancient aliens who unleashed a horde of inimical robots on their foes and were then also extinguished when the robots decided their true mission was to extinguish all living things in the Galaxy, especially all intelligent living things. The appeal has to have something to do with the ambivalence our culture feels toward the machines that support it yet displace people from jobs, make face-to-face personal interactions less frequent (just think of the telephone; we don't even need to mention computer networks), and destroy old traditions. Still more appeal must reside in the way Saberhagen has said that the Berserker machines had things pretty much their own way for eons,

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until they ran into us. And if we haven't been able to lick 'em, at least we've fought 'em to a standstill.

You might think there wasn't room for anything new to be built around the concept, but Saberhagen proves once more how astoundingly fertile is his imagination with his latest, **Berserker Kill.**

The tale opens with the seizure of two isolated explorers by a remarkably ancient and battered Berserker. Atypically, it does not kill its prisoners but simply hovers over them, learning the language. Under what they perceive as a constant threat of torture and annihilation, they go nuts and reveal the existence of a research facility containing a billion human embryos and the artificial wombs needed to rear them to maturity. The embryos are there because Saberhagen's humans have solved the ethical problem of abortion by saying (as some of today's ethicists have said in connection with frozen embryos) that as long as the embryo remains on ice, it hasn't been killed; immorality enters only when one commits some act one expects to result in the embryo's death. Eventually the research facility will be used to plant a colony on some distant world.

The Berserker immediately rushes off to steal the station. In the process, it inflicts quite minimal damage on the worldlet it orbits—just enough to defend itself. It does not act like a Berserker, and it continues its atypical behavior when it permits the people aboard the station, and later the rescue force that gets stranded aboard, to live.

Three centuries later, a quite typical Berserker force rips hell out of the worldlet from which the research station was stolen and breaks off while one human—a condemned prisoner—remains alive. It later emerges that it broke off its attack as soon as it found the record of the previous raid. Now it is hot on the trail of the other Berserker, and the reader is somehow not surprised to find that in due time the two slug it out.

What is going on here? Buried in a welter of subplots involving artificial intelligences and recorded human minds who yearn for bodies, a tinpot dictator who craves a world of his own, a condemned murderer who thinks haring off to blow Berserkers into shrapnel is great fun, and more, there are a few clues. Saberhagen mentions the possibility that humans might once have built self-reproducing von Neumann machines. He also says the Builders, who were responsible for the Berserkers in the first place, also built Berserker-hunting machines. The most important clue, however, is the research station itself, and I won't say any more than that.

Is the story any good? If you're a Berserker fan, you don't even want my opinion. It's enough to know the series still has room to grow. If you're not a fan, well—Saberhagen's prose doesn't sparkle. In fact, it very often plods quite dreadfully so that as he elaborates subplots and red herrings to keep the reader from seeing prematurely where he's going, he tries that reader's patience. Yet the story's there, and the final revelations do a

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lot to reward that patience.

Of course, you can always peek.

First Books was set up to publish novels by writers whose first published fiction appeared in *Aboriginal SF*. Patricia Anthony's **Conscience of the Beagle** is their fourth title, and it's bound to appeal to those who like their maguffins well muddled.

Anthony's first novel, *Cold Allies*, was pretty well received (though I did not review it). This one surely will be too. Here's the situation: An overcrowded and very socially stratified Earth rules its interstellar colonies with an envious hand. It craves both wealth and their *Lebensraum*, and when they get a pretext they take over. One favored pretext seems to be a colony's failure to deal with crime waves, such as the series of terrorist bombings on the theocratic world of Tennyson. As Anthony's tale opens, a crack investigative team led by "Earth's toughest cop," Major Dyle Holloway, is arriving. If they can't crack the case....

Naturally, the colonials are more than a little anxious. Yet they do seem eager to help. Indeed, Minister of Science Vanderslice is all over the case with hints of government conspiracies and revolutionary plots. Meanwhile, the investigators have their own problems. Holloway's wife was brutally murdered, and he's still twitchy. Psychic Szabo and demolitions expert Arne, once lovers, are just as bad off. Beagle—a "construct" or robot bearing the mind of an ace pattern analyst—is the subject of Holloway's jealousy.

Then Holloway stumbles on a hint that Earth's jackbooted Colonial Security has agents on Tennyson, with one of them disguised as Holloway's greatest—and dead—enemy. Beagle finds hints that one or two victims of each terrorist bomb had something in common—a hint that the murders were designed to suppress a scientific discovery. Holloway grasps at solace in the arms of the first target's widow.

Suffice it to say that even though only half of Holloway's team survives, the maguffin gets unmuddled and the reader is amply satisfied. Indeed, the reader is likely to be quite eager to see Anthony's next.

Ben Bova's **Empire Builders** is a sequel to his *Privateers*, in which maverick entrepreneur Dan Randolph defied the powers that be to get into space and make himself a colossal fortune. Yet his enemies remained, and one in particular—Vasily Malik, head of the Global Economic Council—has built into the law that governs both Earth and space just the little gimmick to get Randolph by the short-and-curlies.

The GEC, you see, doesn't like private enterprise. Every time it catches a business violating its rules and regulations, it imposes ruinous fines, confiscates the business, puts bureaucrats in charge, and runs it into the ground. When Randolph buys a business about to be so treated, he is charged with interfering with the GEC and everything he owns in whole or part is confiscated. (Yes, there's precedent—look at how we handle drug dealers.)

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Randolph must now go underground, flee, conspire, all in desperate hope of regaining what he has lost so thoroughly. Sadly, he has hardly any cards at all until Ben complicates his story. The first twist is the realization that the Earth faces a "greenhouse cliff," a sudden jump in the graphs of climate change: within a decade, all hell will let loose at once. The GEC sits on the news, using it to justify its global takeover in the name of central control and coordination. The second twist is the Mafia, with its own representative on the GEC and its own plans to take over, not to coordinate but to loot.

Malik hates Randolph, but he is in essence one of the good guys. He and Randolph now have a pair of common enemies. They can cooperate. Randolph can have his empire back. And perhaps the Earth will be saved.

SF in the classic mold, just the thing for an *Analog* reader.

One of many readers' favorite Ben Bova characters is his boisterous, red-headed, trouble-making, skirt-chasing, entrepreneurial scamp, **Sam Gunn, Unlimited**. If you would like to see Sam's whole history, this book collects the stories and provides a frame. Some time after Sam's death, Jade, a young woman on the Moon, a red-headed orphan abandoned by both her natural and her foster mothers, discovers his reputation. In order to learn more about him she becomes a journalist and wangles the assignment of interviewing all those surviving Gunn associates who are willing to talk. The interviews are the Gunn stories, most of them published in the 1980s and every one of them a paean to the supremacy of the individual Heinleinian man-who-can over soulless corporations and governments. The frame tracks Jade's career and her discovery of kindred spirits (dare I say kinsmen?) among the Gunn people.

The book is the sort known as a "fix-up," cobbled together from shorter pieces. The Heinleinian man-who-can and his superiority over soulless government and big business is one of American SF's favorite myths. *Sam Gunn, Unlimited* is therefore a feel-good fix-up. It's also a good deal of fun and worth a look on that basis even though Bova doesn't add much to the myth, which he has helped create in much of his other work.

Future Earths under South American Skies, edited by Mike Resnick and Gardner Dozois (who have also done a kindred volume called *Future Earths under African Skies*) is an anthology of reprinted stories dealing with South America (including Mexico, which is really part of *North* America, but they *know* that, the introduction assures us). The stories are mostly well enough known to need no description—leading off with James Tiptree, Jr.'s "The Women Men Don't See," and continuing with Lucius Shepard's "Salvador," the late Avram Davidson's "Manatee Gal Ain't You Coming Out Tonight," Orson Scott Card's "America," and more by Will F. Jenkins, Poul Anderson, Pat Murphy, Charles Sheffield, G. C. Edmondson,

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John Kessel, Diane de Avalle-Arce, and Tony Daniel. There are no South American writers here largely because even though they do exist, they are only rarely translated into English.

Been wishin' you could afford a trip to Rio? Here's the next best thing.

You say you *can* afford the trip? You've even got the tickets? Then here's just the thing to take on the plane or boat with you. (Can't you just see DAW coming out with a special line of "Destinations" fiction for a special airport rack? Why, they could even reprint Heinlein's "Destination Moon" script, and then there are Henry Kuttner's *Destination Infinity* and Hugh Walter's kidstuff *Destination Mars.*) ■

IN TIMES TO COME

Bob Eggleton's March cover gives you a dramatic preview of "Waterworld," a novelette, and a most exotic place, cooked up by Lee Goodloe and Jerry Oltion. What kind of a place is it? It's *exactly* what the name suggests, even more literally than you're probably imagining—with all the ramifications that *that* implies. For humans forced to go there, it poses formidable problems indeed. And, popular clichés notwithstanding, adversity doesn't necessarily bring out the best in people. . . .

Hayford Peirce also has a novelette, "To Change a Memory," which some of you will recognize as a sequel to a recent story of his. What you may not recognize quite so easily is that it's part of an evolving series, whose working title I won't reveal now because Hayford hasn't yet gotten where he's eventually going with it. Suffice it to say that it deals with a concept that a couple of other writers have touched on; but as far as I know, nobody before has explored in such detail just what it might do to the shape of civilization.

We'll also have stories by Rick Shelley, Christopher Anvil, and Jack McDevitt; and two fact articles (both short). One is an observation by G. David Nordley that *may* be just an odd coincidence, or *may* have far-reaching consequences for our understanding of the Universe. The other is a "postscript" to a story we published a while back, a central idea in which is rapidly evolving into reality.

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BRASS TACKS

Dear Stan:

Science fiction, particularly *Analog,* is an exceptional forum for ideas.

I absolutely agree with your "Crosstalk" (June 1993), but we should be aware that people can get in trouble when they purport to understand what scientists in disciplines other than theirs have written. For example, what outraged scientists so much about Immanuel Velikovsky (*Worlds in Collision*) back in 1950 was not that he might be wrong about worldwide catastrophes—most of his critics had never read his works or done their homework to refute him—but that he had dared to sit in the library reading the works of specialized scholars and drawing conclusions from them. I am not sure academia has become much more tolerant in four decades.

(To my knowledge, Velikovsky was the first modern to suggest, *based on physical evidence alone,* that [a] evolution moved in cataclysmic jerks—I believe that "punctuated equilibria" is the term coined by Steven Jay Gould and others— and [b] the cause related to other celestial bodies. See *Earth in Upheaval* [1955]. I don't think he ever got any recognition for that, and certainly not after Carl Sagan's 1976 "Analysis" demolished his particular proposed explanation [celestial near miss, rather than collision] in 1976.)

Regarding all the assassinations of world political leaders, it looks like SF was, in this area, too, ahead of its times. Remember Robert Sheckley's "Citizen in Space," where any citizen had the right to go down to City Hall to register disapproval of an elected official. The registration triggered an explosive in the official's ceremonial necklace, making "a permanent black mark against [his] record." In today's well-weaponed world, almost any true-believing individual can become an arbiter of the destiny of millions of others.

Concerning the debate about a culture needing a common language (e.g. January 1993), Piers Anthony may have demonstrated the arguments better than any essay in the context of *Politician* (Book 3 of the "Bio of a Space Tyrant" series, pp. 208-210).

Finally, regarding technology, it is scary to remember that Winston Smith's job in Orwell's *1984* was to change the archives, thus changing the record of the past. With computers, data bases, and, above all, digitalization and manipulation of images, I

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am not sure that any of our past is fixed. A lot of people will have both access to the main data bases and the capability of changing them. What are we going to do to protect our records? Can we ever be sure again?

I wish our academics and politicians would read science fiction more often.

JEFFREY LISS

Dear Dr. Schmidt:

I don't generally write letters in response to other letters in magazines. However, several letter-writers in your July 1993 issue raised issues I'd like to address, if I may.

Erik Buck suggests that we repeal the Seventeenth Amendment to the Constitution, which provides for direct election of U.S. senators, on the theory that "if they don't have to buy TV ads, they can be held to more ethical standards" in campaign funding. Maybe so, but before this amendment was passed the situation was *not* better: the state legislatures elected senators, whom the ordinary voters could only hope would be more responsive to their concerns than to those of cash-flush lobbyists for the "special interests" of the day ("big business," almost exclusively). Nor would the lottery system he proposes improve matters, since it would take elections altogether outside the realm of human judgment and place the composition of the Senate at the mercy of pure chance. (Or impure chance: what about fixes? It seems to me those would be easier under the lottery system than they are now.)

Jeffrey R. Carter suggests we use technology to eliminate the need for our elected representatives altogether, and establish an electronic direct democracy (something like what Ross Perot has proposed, perhaps?). You point out that most people might not have the time or motivation for politics to do it well. There's another aspect to that: those who'd really be motivated would tend to be activists of one sort or another, with views more extreme than those of the people as a whole (this is already the case in party caucuses, and in many primaries, especially in smaller states).

Finally, Nicholas J. Condon writes to object to restrictions he has encountered on racist and sexist speech and displays. On what might be termed "fundamentalist" First Amendment grounds, I have to agree in principle (somewhat uneasily). However, he goes on to complain that these restrictions can't be lived with except by abandoning "our senses of humor and a large part of our vocabularies." He says he can't think of a single joke which meets these standards and is still funny. I don't know . . . it seems to me that someone who doesn't know a single unbigoted joke he thinks is funny, and "a large part" of whose vocabulary is made up of ethnic, racial and sexual slurs, has more problems to deal with than "P.C. fascism."

ERIC B. LIPPS

Staten Island, NY

Dear Mr. Condon,

Your letter in the July '93 *Analog* echoed arguments against "Political Correctness," which have been get-

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ting an airing lately, so I'm using it as a catalyst to sit down finally and organize a response. You argued that "diversity" should include your right to express "certain thoughts considered racist or sexist."

First, I greet with skepticism your assertion that you "aren't racist or sexist in any way"—yet you defend your right to talk as if you are, through the use of objectionable vocabulary and degrading humor. This seems a specious distinction. How do you define racists or sexists, if not by their speech? You might want to examine yourself a bit more fearlessly and objectively.

The important issue is the definition of the word "diversity." To me, the word "diversity" carries a crucial connotation which prevents using it to justify sexist and racist thinking: the *absence of hierarchical ranking.* Diversity implies *appreciation* of differences rather than using them as an excuse to enhance one's own status at the expense of the Other, which is the function of sexism and racism.

Surely it has not escaped your attention that favorable or neutral terms for gender and racial difference are not coming under criticism. Only demeaning, hostile and humiliating terminology is objectionable. Can you not feel that defending your "right" to demean and humiliate others is destructive? Everyone agrees that "your right to swing your fist ends where my face begins," yet words can be even more powerful than blows because their effects are more lasting. Exercising your "right" to batter me with words is a vote of support for the violence and hostility which plague our planet at this time. Do not underestimate the profound influence of words in creating and maintaining cultural attitudes. What do you think culture is, if not the transmittal of ideas? We are each personally responsible for the climate of cooperation or conflict we transmit.

A new paradigm is struggling for emergence in our status-obsessed culture, and none too soon. It is the concept of reciprocity, mutuality, interdependence, the resilience and adaptability engendered by a system employing diverse components rather than a susceptible monoculture. It has been termed "linking" as opposed to the old "ranking" paradigm. In order for you to be good, it is not necessary for me to be bad. We can be different without being greater or lesser, demeaned or demeaning. This takes the punch (hence the "fun"?) out of sexist and racist put-down "humor."

It's sad that you "cannot think of a single joke at this time that stays within the bounds of Political Correctness and remains amusing." What a limited, unsophisticated sense of humor you must possess! Yet I would be willing to concede your right to use degrading humor, provided you were restricted to jokes in which you yourself were the object of humiliation. For example, only fair-haired women would have the right to tell "Blonde" jokes; and you would be limited to jokes about honkies with tiny little. . . .

WENDOLYN ALTER

Bellingham, WA

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Mr. Condon may have overstated his case about Politically Correct jokes, but he also made some valid and important points which you seem to have missed (and you've also assumed a great deal in your response). The most important point is not that humor has to be racist or sexist (I agree, it doesn't), but that some of the current "thought police" have become so zealous in their search for those qualities that they find them even where they don't exist—and allowing censorship on such a basis is a dangerous and scary thing.

Dear Dr. Schmidt:

It seems to me that public pressure directly related to science fiction movies and/or books has had considerable influence on public policy. Look at all the fuss that is generated by anything that is "genetically altered," whether it is tomatoes, strawberries, or milk from genetically engineered cattle. Never mind real science. The fear of "mutant strains" generates letters to Congress. Don't you think it's worth some study? The phenomenon is related to, but not identical with, such things as the Alar hoax and the unproven but widely believed "global warming."

An article on the influence of science fiction on public policy could address such questions as the hole in the ozone layer. Is it getting worse? Is it getting better because public pressure (partially influenced by SF) brought about changes in policy? Was there ever a problem in the first place?

One of your talented writers could do a lot with this topic. Or maybe some young person could get a Ph.D. dissertation out of it.

J. EDGAR WILLIAMS
(reader since 1943)
Carrboro, NC

Dear Dr. Schmidt:

Spider Robinson's cluricaune, in "The End of the Painbow," (July 1993) repeats a canard (an unlucky canard, by the way), namely that no one in *Citizen Kane* heard Kane's last word. Alas, Mr. Robinson needs, ah, more A-movie knowledge. The butler did it. Toward the end of the film, Kane's butler specifically tells a reporter that he was present at the deathbed and heard Kane say "Rosebud" just before he died. Of course, the butler might have made the whole thing up to create a sensational news story—thus following the best, and Hearst, traditions of the Kane newspapers.

Or maybe Mr. Robinson is setting up a sequel? The cluricaune's so-far undetected lie helped give him an in at the inn. We already know he is not pukka. There could be something sinister left to come.

MICHAEL HERBERT
Richmond, VA

Dear Dr. Schmidt,

First of all, I want to thank you for years of leisure time activity that exercises my brain. I have always enjoyed Spider Robinson's "bar" stories. I feel they are "Cheers" with a much higher IQ and more interesting characters. However, I wondered about a phrase in his most recent installment,

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"The End of the Painbow."

Doc Webster says, "I understood that the Daoine Sidh were mythical. Like ghosts, and channeled entities, and commercial kiddy porn. Not real."

Did Mr. Robinson mean to imply that child pornography doesn't exist? Or is it simply the character who is seriously misinformed? Unfortunately, child pornography is alive and well. The most frightening aspect is the number of pedophiles desiring this material who make this highly illegal activity profitable.

If denial were a cure, AIDS, the homeless, and the rainforest would all be cured today. Sexual child abuse absolutely thrives on denial. Perhaps a sexual abuse counselor should drop by Mary's Place and have a chat with Doc Webster.

CAROL LEWIS

San Diego, CA

The author replies. . . .

Dear Stan,

I thank Ms. Lewis for her kind words . . . although I diffidently point out that my Callahan series predates "Cheers" by many years. As to her query—I am not as reckless as Sam Webster, myself: I won't say that commercial child pornography does not exist in North America. But I must report that in thirty years of casual but informed search, I have utterly failed to find any.

I have spent a good deal of time in porn shops across the continent. (I don't criticize anyone who hasn't . . . *unless* they claim to be a serious student of human nature.) The variety of types of porn commercially available has always amazed and cheered me. But what is *not* on the shelves is as interesting. Violence, for example. No matter what you've heard, there's virtually none in porn—and the rare exception is always very tame compared to the average horror movie or even action thriller, *pointedly* fakey. And in three decades and twenty-odd major cities, I have *never* seen AUTHENTIC, VISUAL kiddy porn offered for sale, rent or trade.

About twenty years back, in a spirit of scientific inquiry, I took to sidling up to the counter and asking if they had anything "stronger, for special customers"—while displaying bills of large denomination. Perhaps I should add that I have never in my life resembled a cop or even a respectable citizen. Over the years, this gambit often produced something genuinely astonishing. But *never* was kid porn even hinted at. Once—only!—*I* hinted, to see what would happen. I was thrown bodily out onto 42nd Street and forbidden to return. (Talk about your social distinctions!)

Now let's discuss the loopholes in caps in paragraph 2. Years ago, one did sometimes see (rarely, but always *over* the counter) magazines featuring young women shaved and/or dressed to *appear* childish; invariably the deception was pathetically obvious and the illusion unconvincing. And I have seen plenty of *written* porn involving minors (though not in years)—but that is evidence only that someone has used his or her imagination in a taboo area: it is *not* proof

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that any actual child was abused. I'll tolerate some restraints on sexual behavior—but *none* on imagination.

Yes, there have existed pedophiles suicidally stupid enough to photograph their unfortunate victims, and a small percentage seem to have been reckless enough to share their "trophies" with individuals of the same bent (and I used the term advisedly), sometimes in exchange for cash. But this is not commercial kiddy porn by any reasonable definition. (To call something a one-in-a-million rarity is to state that there are probably over 225 examples in the U.S. alone—more than enough to make the news, without constituting a significant trend in commerce.)

Having said all this, let me now declare that commercial kiddy porn *does* exist in North America. I've never actually seen any, though, because I do not care to have any more dealings than absolutely necessary with its sole source: the federal government of the United States....

The feds import it from places like Denmark (where it is quite rare, though tolerated), and use it as bait to entrap pedophiles. They send it through the mail to sick people stupid and/or driven enough to answer veiled ads in the back of porn magazines—then raid their homes and "find" it there, the moral equivalent of a corrupt cop's drop-gun or plant-stash. Ask them if you don't believe me: they boast about it. Sometimes they turn up the wretch's own sorry souvenirs from his last trip to Amsterdam—or, rarely, private photos or videos of abused kids—and add that to the bait-pile... but studies say 85+% of the total heap is of gummint origin. And once in a while, they do catch in this manner someone who can be proven to have actually molested some children, as opposed to fantasizing about it, and so I hesitate to totally condemn the practice. But entrapment always stinks.

In the last decade I haven't been in a porn shop more often than annually, to check the pulse, as it were—my last sampling was in Orlando, fall '92. But I just phoned a friend and fan who retails the stuff; she confirms that it is not and has never been possible to obtain visual kiddy porn from any source known to her. It's pesky difficult to prove a negative, so I cannot say flatly that commercial kidporn (other than taxpayer-supported) does not exist in North America. But I have seen much more, and much more persuasive, evidence for the existence of flying saucers. Or ghosts or channeled entities... or the Daoine Sidh, for that matter!

I believe that to be "in denial," absent evidence, is better than being uncritically "in acceptance" of any assertion shocking enough to be titillating—especially in witch-hunt season, which, if anyone has failed to notice it, is upon us. If we really want to stop sexual child abuse—and I certainly do—we waste time and energy pursuing mythical marketers. I would be interested to hear from any *Analog* reader who has *hard evidence* to offer for the existence of commercial child pornography; those with mere religious convictions on the matter, however passionate, are asked not to

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waste time (mine) and kill trees responding. But if anyone feels the need to go on a righteous crusade—may I suggest they try to get the U.S. Justice Department's National Obscenity Enforcement Unit to stop trampling on the Constitution by deliberately prosecuting sellers of erotica (including lingerie-only distributors) with unwinnable cases—*but in multiple jurisdictions at once!*—then using that economic leverage to force them to swear they'll literally never again sell so much as a copy of *The Joy of Sex* or a reproduction of Michaelangelo's David? This filthy and illegal practice has been going on since 1987, with nary a peep from the public. Now, *that's* sexual abuse, counselor. . . .

SPIDER ROBINSON

Dear Stan:

I'd like to thank *all* the *Analog* readers for voting my piece for best cover. It was quite a surprise, and it truly means more than I can say in words. "Because It's There" was one great story and I'd always wanted to do a mountain climbing illustration. Little did I know it would be an SF scene as well!

BOB EGGLETON

Dear Stan:

Ya done it again! Kallis *did not* originate the immortal, "Any sufficiently advanced magic is indistinguishable from technology" (September 1993). Even though *you* used this phrase to introduce his story, "Fate of the Art," over a year ago (at which time I pointed this out, though not strongly enough, I fear), I originated this ultimate pun in my story in *Analog* in years past, in "Indian Summa" (January 1989).

So, I have missed one more opportunity at salvaging my immortality. I do humbly request a correction at yr. earliest conven'ce.

ARLAN ANDREWS

Consider it done, with profuse apologies for the slip. Everyone please note: "Any sufficiently advanced magic is indistinguishable from technology" is ANDREWS'S LAW! ■

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UPCOMING EVENTS Anthony Lewis

11-13 February
POTLATCH III (Seattle area SF conference) at University Plaza Hotel, Seattle, Wash. Oriented towards written SF. Registration: $30. Info: Potlatch III, Box 31848, Seattle WA 98103. (206) 634-3828. Limited to 200.

12-14 February
NEUROCON (Seattle area Star Wars conference) at SeaTac Radisson Hotel, Seattle, Wash. Guest of Honor: Tom Maddox. Registration: $20 (to Imperial Starbase Seattle). Info: Neurocon, 24026 21st Ave. S., Seattle WA 98198. (206) 244-6000.

18-20 February
BOSKONE XXXI (New England SF conference) at the Sheraton Tara, Framingham, Mass. Guests of Honor: Emma Bull & Will Shetterly; Official Artist: Nicholas Jainschigg; Special Guests: Patrick & Teresa Nielsen Hayden. Registration: $30 until 15 January, more at the door. Info: Post Office Box 809, Framingham MA 01701-0203.

3-6 March
WORLD HORROR CONVENTION at Fountain Suites Hotel, Phoenix, Ariz. Guests of Honor: Charles Grant and Dan Simmons; Artist Guest of Honor: Gahan Wilson; TM: Edward Bryant. Registration: $75. Info: World Horror Convention, Box 60008, Phoenix AZ 85082-0008. (602) 841-5153 or 945-6890.

1-5 September
CONADIAN (52nd World Science Fiction Convention) at Convention Centre, Winnipeg, Manitoba. Guest of Honour: Anne McCaffrey; Artist Guest of Honour: George Barr; Fan Guest of Honour: Robert Runté; TM: Barry Longyear. Registration: $85 (C$95) adult, $30 (C$35) child until 30 September 1993; Supporting: $25 (C$30). This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: Conadian, Box 2430, Winnipeg MB R3C 4A7 Canada or Box 7111, Fargo ND 58109 (204) 942-9494; FAX (204) 942-3427.

You can send me e-mail about your convention—A.LEWIS20 on the GEnie™ network. When calling conventions for information—do not call collect and do not call too late in the evening. ■

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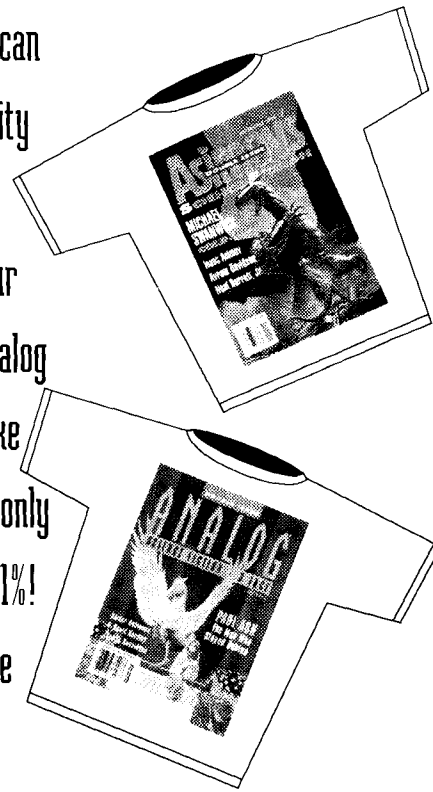

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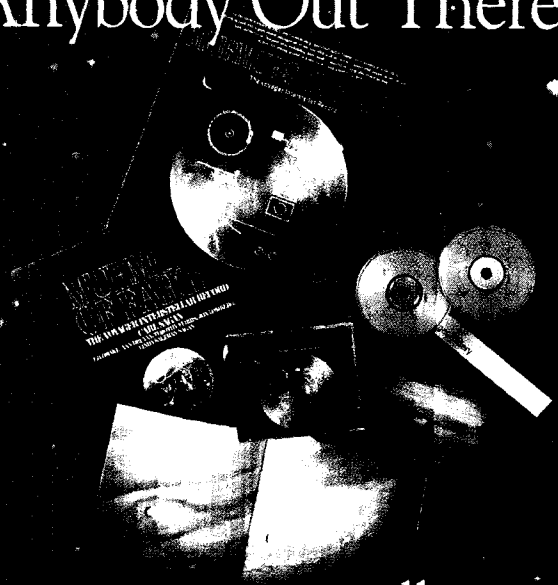

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